CALIFORNIA HIGH-SPEED TRAIN

Program Environmental Impact Report/Environmental Impact Statement

Los Angeles – Orange County – San Diego

HYDROLOGY & WATER QUALITY TECHNICAL EVALUATION

January 2004

Prepared for:

California High-Speed Rail Authority

U.S. Department of Transportation
Federal Railroad Administration

CALIFORNIA HIGH SPEED RAIL AUTHORITY

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CALIFORNIA HIGH-SPEED TRAIN PROGRAM EIR/EIS

Los Angeles – Orange County – San Diego Hydrology & Water Quality Technical Evaluation

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for
IBI Group

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AUTHORITY	CALIFORNIA HIGH-SPEED RAIL AUTHORITY
ACOE	U.S. ARMY CORPS OF ENGINEERS
BMPS	BEST MANAGEMENT PRACTICES
CCBA	CALIFORNIA COASTAL BASIN AQUIFER
CDFG	CALIFORNIA DEPARTMENT OF FISH AND GAME
CEQA	CALIFORNIA ENVIRONMENTAL QUALITY ACT
COG	COUNCIL OF GOVERNMENTS
CWA	CLEAN WATER ACT
DLG	DIGITAL LINE GRAPH
DOT	U.S. DEPARTMENT OF TRANSPORTATION
DWR	DEPARTMENT OF WATER RESOURCES
EIR	ENVIRONMENTAL IMPACT REPORT
EIS	ENVIRONMENTAL IMPACT STATEMENT
EPA	ENVIRONMENTAL PROTECTION AGENCY
FAA	FEDERAL AVIATION ADMINISTRATION
FEMA	FEDERAL EMERGENCY MANAGEMENT ACT
FHWA	FEDERAL HIGHWAY ADMINISTRATION
FIRM	FEDERAL INSURANCE RATE MAP
FRA	FEDERAL RAILROAD ADMINISTRATION
FTA	FEDERAL TRANSIT ADMINISTRATION
HSRA	HIGH-SPEED RAIL AUTHORITY
HST	HIGH-SPEED TRAIN
MTA	METROPOLITAN TRANSPORTATION AUTHORITY
NEPA	NATIONAL ENVIRONMENTAL POLICY ACT
NFIP	NATIONAL FLOOD INSURANCE PROGRAM
NOI	NOTICE OF INTENT
NPDES	NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
ROW	RIGHT-OF-WAY
RTP	REGIONAL TRANSPORTATION PLAN
RWQCB	REGIONAL WATER QUALITY CONTROL BOARD
SFHA	SPECIAL FLOOD HAZARD AREA
STATSGO	STATE SOIL GEOGRAPHIC DATABASE
STIP	STATE TRANSPORTATION IMPROVEMENT PROGRAM
SWPPP	STORMWATER POLLUTION PREVENTION PROGRAM
SWRCB	STATE WATER RESOURCES CONTROL BOARD
TMDL	TOTAL MAXIMUM DAILY LOADS
USACE	U.S. ARMY CORPS OF ENGINEERS
USFWS	U.S. FISH AND WILDLIFE SERVICE
USGS	UNITED STATES GEOLOGICAL SURVEY

1.0 INTRODUCTION

The California High-Speed Rail Authority (Authority) was created by the Legislature in 1996 to develop a plan for the construction, operation, and financing of a statewide, intercity high-speed passenger train system.[1] After completing a number of initial studies over the past six years to assess the feasibility of a high-speed train system in California and to evaluate the potential ridership for a variety of alternative corridors and station areas, the Authority recommended the evaluation of a proposed high-speed train system as the logical next step in the development of California's transportation infrastructure. The Authority does not have responsibility for other intercity transportation systems or facilities, such as expanded highways, or improvements to airports or passenger rail or transit used for intercity trips.

The Authority adopted a *Final Business Plan* in June 2000, which reviewed the economic feasibility of a 1,127-kilometer-long (700-mile-long) high-speed train system. This system would be capable of speeds in excess of 321.8 kilometers per hour (200 miles per hour [mph]) on a dedicated, fully grade-separated track with state-of-the-art safety, signaling, and automated train control systems. The system described would connect and serve the major metropolitan areas of California, extending from Sacramento and the San Francisco Bay Area, through the Central Valley, to Los Angeles and San Diego. The high-speed train system is projected to carry a minimum of 42 million passengers annually (32 million intercity trips and 10 million commuter trips) by the year 2020.

Following the adoption of the Business Plan, the appropriate next step for the Authority to take in the pursuit of a high-speed train system is to satisfy the environmental review process required by federal and state laws which will in turn enable public agencies to select and approve a high speed rail system, define mitigation strategies, obtain necessary approvals, and obtain financial assistance necessary to implement a high speed rail system. For example, the Federal Railroad Administration (FRA) may be requested by the Authority to issue a *Rule of Particular Applicability*, which establishes safety standards for the high-speed train system for speeds over 200 mph, and for the potential shared use of rail corridors.

The Authority is both the project sponsor and the lead agency for purposes of the California Environmental Quality Act (CEQA) requirements. The Authority has determined that a Program Environmental Impact Report (EIR) is the appropriate CEQA document for the project at this conceptual stage of planning and decision-making, which would include selecting a preferred corridor and station locations for future right-of-way preservation and identifying potential phasing options. No permits are being sought for this phase of environmental review. Later stages of project development would include project-specific detailed environmental documents to assess the impacts of the alternative alignments and stations in those segments of the system that are ready for implementation.

The decisions of federal agencies, particularly the Federal Railroad Administration (FRA) related to high-speed train systems, would constitute major federal actions regarding environmental review under the National Environmental Policy Act (NEPA). NEPA requires federal agencies to prepare an Environmental Impact Statement (EIS) if the proposed action has the potential to cause significant environmental impacts. The proposed action in California warrants the preparation of a Tier 1 Program-level EIS under NEPA, due to the nature and scope of the comprehensive high-speed train system proposed by the Authority, the need to narrow the range of alternatives, and the need to protect/preserve right-of-way in the future. FRA is the federal lead agency for the preparation of the Program EIS, and the Federal Highway Administration (FHWA), the U.S. Environmental Protection Agency (EPA), the U.S. Corps of Engineers (USACE), the Federal Aviation Administration (FAA), the U.S. Fish and Wildlife Service (USFWS), and the Federal Transit Administration (FTA) are cooperating federal agencies for the EIS.

[1] Chapter 796 of the Statutes of 1996; SB 1420, Kopp and Costa

A combined Program EIR/EIS is to be prepared under the supervision and direction of the FRA and the Authority in conjunction with the federal cooperating agencies. It is intended that other federal, state, regional, and local agencies will use the Program EIR/EIS in reviewing the proposed program and developing feasible and practicable programmatic mitigation strategies and analysis expectations for the Tier 2 detailed environmental review process which would be expected to follow any approval of a high speed train system.

The statewide high-speed train system has been divided into five regions for study: Bay Area-Merced, Sacramento-Bakersfield, Bakersfield-Los Angeles, Los Angeles-San Diego via the Inland Empire, and Los Angeles-Orange County-San Diego. This Hydrology and Water Quality Technical Evaluation for the Los Angeles-Orange County-San Diego region is one of five such reports being prepared for each of the regions on the topic, and it is one of fifteen technical reports for this region. This report will be summarized in the Program EIR/EIS and it will be part of the administrative record supporting the environmental review of alternatives.

1.1 ALTERNATIVES

1.1.1 No-Project Alternative

The No-Project Alternative serves as the baseline for the comparison of Modal and High-Speed Train alternatives (Figure 1-1). The No-Project Alternative represents the state's transportation system (highway, air, and conventional rail) as it existed in 1999-2000 and as it would be after implementation of programs or projects currently programmed for implementation and projects that are expected to be funded by 2020. The No-Project Alternative addresses the geographic area serving the same intercity travel market as the proposed high-speed train (generally from Sacramento and the San Francisco Bay Area, through the Central Valley, to Los Angeles and San Diego). The No-Project Alternative satisfies the statutory requirements under CEQA and NEPA for an alternative that does not include any new action or project beyond what is already committed.

The No-Project Alternative defines the existing and future statewide intercity transportation system based on programmed and funded (already in funded programs/financially constrained plans) improvements to the intercity transportation system through 2020, according to the following sources of information:

- State Transportation Improvement Program (STIP)
- Regional Transportation Plans (RTPs) for all modes of travel
- Airport plans
- Intercity passenger rail plans (California Rail Plan 2001-2010, Amtrak Five- and Twenty-year Plans)

The No-Project Alternative for the Los Angeles-Orange County-San Diego Region includes highway expansion as well as conventional rail improvements to the existing LOSSAN corridor that are programmed and funded for implementation through 2020. Table 1-1 summarizes the infrastructure components of the No-Project Alternative for this Region. As with all of the alternatives, the No-Project Alternative will be assessed against the purpose and need topics/objectives for congestion, safety, air pollution, reliability, and travel times.

FIGURE 1-1

No-Project Alternative – California Transportation System

TABLE 1-1
PROGRAMMED IMPROVEMENTS INCLUDED IN THE NO-PROJECT ALTERNATIVE
LOS ANGELES-ORANGE COUNTY-SAN DIEGO REGION
(from 1998 and 2000 Regional Transportation Plans)

County	Type of Project	Description
INTERCITY HIGHWAY PROJECTS		
Los Angeles	HOV	HOV Project on SR-14 (Ave P-8 to Ave-L)
Los Angeles	HOV	HOV Project on I-710 (I-10 to I-210
Los Angeles	HOV	HOV Project on I-5 (SR-19 to I-710)
Los Angeles	Highway Widening	I-710 (I-10 to I-210) Additional Mixed Flow Lane
Los Angeles	Highway Widening	I-5 (Rosecrans to Orange Co) Additional Mixed Flow Lane
Los Angeles	Highway Widening	I-405 (US-101 to I-105) Additional Mixed Flow Lane
Los Angeles	Highway Widening	SR-57 (SR-60 to Orange Co) Additional Mixed Flow Lane
Orange	HOV	HOV Project on I-5 (SR-1 to Avenida Pico)
Orange	Highway Widening	I-5 (SR-91 to Los Angeles Co) Additional Mixed Flow Lane
Orange	Highway Widening	SR-91 (westbound auxiliary lane SR-57 to I-5) Additional Mixed Flow La
Orange	Highway Widening	SR-91 (auxiliary lanes SR-241 to SR-71) Additional Mixed Flow Lane
Orange	Highway Widening	SR-57 (auxiliary lanes Los Angeles Co to SR-91) Additional Mixed Flow Lane
San Diego	Highway Interchange/Widening	I-5 at I-805 – New interchange with 10 freeway and 2 HOV lanes.
San Diego	Highway Widening	I-5 from Mission Bay Drive to SR-52 – Addition of a northbound auxiliary lane.
San Diego	Highway Widening	I-5 at SR-78 Interchange: NB-EB Connector – Widen auxiliary lane and ramp.
San Diego	Highway Widening	I-15 from SR-163 to SR 78 – Addition of auxiliary lanes and meters. Bridge widening
San Diego	Highway Widening	I-15 from SR-56 to Centre City Parkway – Addition of 4 HOV/Managed lanes
San Diego	Highway Widening/HOV	I-5 from Del Mar Heights Road to Birmingham Drive – Upgrade from existing 8 lane freeway to 12-lane freeway and 2 HOV lanes.
San Diego	Highway Interchange	I-15/SR-56 Interchange Ramp (EB-NB) – Loop ramp.
San Diego	Highway Widening/HOV	I-5 from Del Mar Heights Road to Encinitas Boulevard – Upgrade from 8-lane freeway to 12-lane freeway and 2 HOV lanes.
San Diego	Highway	I-5 from Encinitas Boulevard to La Costa Boulevard – Upgrade from 8-lane freeway to 10-lane freeway and 2 HOV lanes.
San Diego	Highway	I-15 from SR-163 to SR-56 – Addition of 4 HOV/Managed lanes.
San Diego	TSM	Intelligent Transportation Systems: Enhanced Incident/Emergency Response, Traveler/Commercial Vehicle Operations Information, and Management Syster Software.
CONVENTIONAL RAIL IMPROVEMENTS		
Los Angeles	Conventional Rail	Run through tracks at L.A. Union Station
Los Angeles	Conventional Rail	Continuous third main track from Union Station to Fullerton
Orange	Conventional Rail	Double tracking along Lincoln Avenue in Santa Ana
San Diego	Conventional Rail	Extension of Double-Track at San Onofre
San Diego	Conventional Rail	Extension of Double-Track in Oceanside
San Diego	Conventional Rail	Sorrento-Miramar Double-Tracking and Curve Realignment
San Diego	Conventional Rail	O'Neil to Flores Double-Tracking
San Diego	Conventional Rail	Santa Margarita River Bridge Replacement and Double-Tracking
San Diego	Conventional Rail	Fallbrook Junction Track Upgrades
San Diego	Conventional Rail	Del Mar Bluffs Stabilization
San Diego	Conventional Rail	False Bay Passing Track
San Diego	Conventional Rail	Tecolote Creek Track Improvements and Bridge Replacement

Source: Parsons Brinckerhoff, California High-Speed Train Program Environmental Impact Report/Environmental Impact Statement, *System Alternatives Definition,* November 18, 2002

1.1.2 Modal Alternative

There are currently only three main options for intercity travel between the major urban areas of San Diego, Los Angeles, the Central Valley, San Jose, Oakland/San Francisco, and Sacramento: vehicles on the interstate highway system and state highways, commercial airlines serving airports between San Diego and Sacramento and the Bay Area, and conventional passenger trains (Amtrak) on freight and/or commuter rail tracks. The Modal/System Alternative consists of expansion of highways, airports, and intercity and commuter rail systems serving the markets identified for the High-Speed Train Alternative (Figures 1-2 and 1-3). The Modal Alternative uses the same inter-city travel demand (not capacity) assumed under the high-end sensitivity analysis completed for the high-speed train ridership in 2020. This same travel demand is assigned to the highways and airports and passenger rail described under the No-Project Alternative, and the additional improvements or expansion of facilities is assumed to meet the demand, regardless of funding potential and without high-speed train service as part of the system.

The Modal Alternative for the Los Angeles-Orange County-San Diego Region is defined as further expansion of Interstate 5 (beyond the expansion planned under the No-Project Alternative), as well as expansion at the Long Beach Airport. Table 1-2 summarizes the highway expansion components of the Modal Alternative for this Region.

TABLE 1-2

Modal Alternative: Highway Capacity Improvement Options for Year 2020
Los Angeles – Orange County – San Diego Region
(2020 Intercity Travel Demand with Highway Expansion only)

Highway Corridor	Segment (To-From)	No. of Additional Lanes[1] (Total – Both Directions)
I-5	L.A. Union Station to I-10	4
I-5	I-10 to Norwalk	2
I-5	Norwalk to Anaheim	2
I-5	Anaheim to Irvine	2
I-5	Irvine to I-405	2
I-5	I-405 to SR-78	2
I-5	SR-78 to University Town Center	2
I-5	University Town Center to San Diego Airport	2

Source: Parsons Brinckerhoff, California High-Speed Train Program Environmental Impact Report/ Environmental Impact Statement, System Alternatives Definition, November 18, 2002

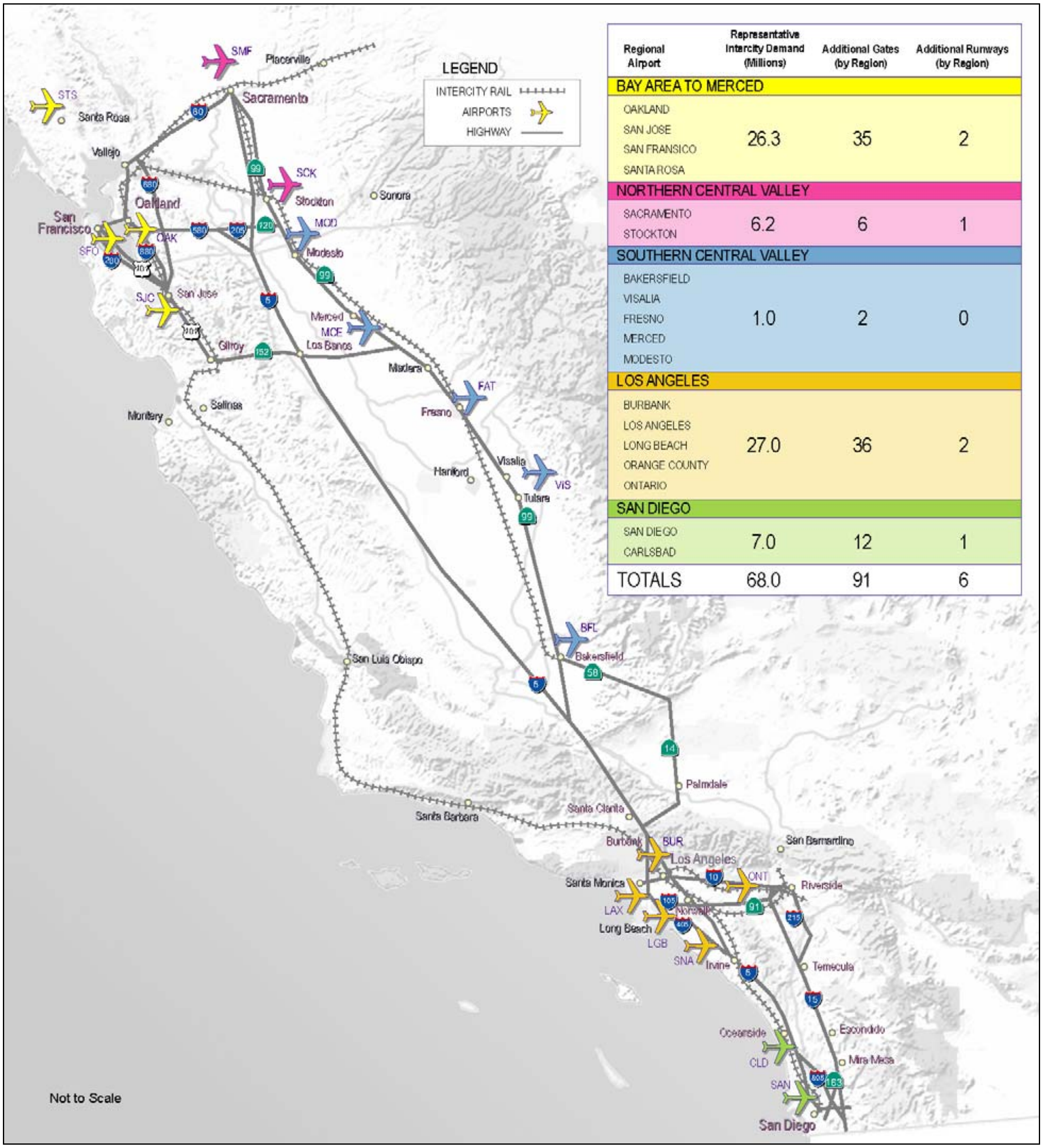
1. Represents the number of through lanes, in addition to the total number of lanes in the No-Project Highway Network, that approximate an equivalent level of capacity to serve the representative demand.

FIGURE 1-2

Modal Alternative – Highway Component

FIGURE 1-3

Modal Alternative – Aviation Component



Regional Airport	Representative Intercity Demand (Millions)	Additional Gates (by Region)	Additional Runways (by Region)
BAY AREA TO MERCED			
OAKLAND SAN JOSE SAN FRANSICO SANTA ROSA	26.3	35	2
NORTHERN CENTRAL VALLEY			
SACRAMENTO STOCKTON	6.2	6	1
SOUTHERN CENTRAL VALLEY			
BAKERSFIELD VISALIA FRESNO MERCED MODESTO	1.0	2	0
LOS ANGELES			
BURBANK LOS ANGELES LONG BEACH ORANGE COUNTY ONTARIO	27.0	36	2
SAN DIEGO			
SAN DIEGO CARLSBAD	7.0	12	1
TOTALS	68.0	91	6

1.1.3 High-Speed Train Alternative

The Authority has defined a statewide high-speed train system capable of speeds in excess of 200 miles per hour (mph) (320 kilometers per hour [km/h]) on dedicated, fully grade-separated tracks, with state-of-the-art safety, signaling, and automated train control systems. State of the art high-speed steel-wheel-on-steel-rail technology is being considered for the system that would serve the major metropolitan centers of California, extending from Sacramento and the San Francisco Bay Area, through the Central Valley, to Los Angeles and San Diego (Figure 1-4).

The High-Speed Train Alternative includes several corridor and station options. A steel-wheel on steel-rail, electrified train, primarily on exclusive right-of-way with small portions of the route on shared track with other rail is planned. Conventional "non-electric" improvements are also being considered along the existing LOSSAN rail corridor from Los Angeles to San Diego. The train track would be either at-grade, in an open trench or tunnel, or on an elevated guideway, depending on terrain and physical constraints.

In the Los Angeles-Orange County-San Diego Region, the High-Speed Train Alternative consists of electrified rail options north of Irvine (described in this report as High-Speed Rail or HSR), and improvements and options for the existing LOSSAN rail corridor between Los Angeles and San Diego (described in this report as Conventional Rail).

For purposes of comparative analysis the HST corridors will be described from station-to-station within each region, except where a by-pass option is considered when the point of departure from the corridor will define the end of the corridor segment. Table 1-3 summarizes the segments, improvements, and alignment and station options evaluated for the Los Angeles-Orange County-San Diego Region. The alignment segments are shown (north to south) in Figures 1-5A, B and C. These figures also show the proposed construction type for each alignment option (open trench, covered trench, tunnel, at-grade, or elevated), and where the alignment options would be located outside of an existing rail corridor.

LOSSAN Corridor Screening Process

A strategic planning process was undertaken as part of the evaluation of Conventional Rail improvements in the LOSSAN Corridor. This process was used to gain additional public input on the various rail improvement options being considered, and to reduce the number of alternatives to those that most reasonably and feasibly can meet the objectives, purpose, and need for the project. There are four locations within the LOSSAN Corridor where the initial range of alternatives was sufficiently broad to allow for the screening, or narrowing, of the alternatives to be carried forward in the Program EIR/EIS: San Juan Capistrano, Dana Point/San Clemente, Encinitas, and Del Mar.

Based on public and agency input, and technical, environmental and economic evaluations, a number of alternatives described in this technical report were subsequently eliminated from further consideration. The alternatives eliminated are shown in Table 1-3 in italics and gray shading. The environmental evaluation of these alternatives is included in this technical report, and was considered in the screening process. More detail on the screening process for the LOSSAN Corridor can be found in the final *Los Angeles to San Diego via Orange County Conventional Improvements Screening Report* (Authority, 2003).

FIGURE 1-4

High-Speed Train Alternative – Corridors and Stations for Continued Investigation

TABLE 1-3

Alignment and Station Options for High-Speed Train Alternative Los Angeles – Orange County – San Diego Region

Alignment Segments and Station Locations Evaluated[1]	Description of Proposed Options & Improvements
HIGH-SPEED RAIL (HSR) & STATION OPTIONS	
LAX To Union Station	Construction of an electrified, grade-separated, dedicated track within an existing rail corridor. The train would be on an elevated structure from Union Station to Alameda Street, then transition into a trench that ends at LAX.
Stations	
LAX	New underground station.
Union Station To Anaheim Station via UPRR	Construction of an electrified, grade-separated, dedicated track within an existing rail corridor. Train would be on an elevated structure from Union Station, go into a trench at Slauson Avenue, move to at-grade across San Gabriel River, return to a trench up to La Canada Verde Creek, then become an aerial structure to Edison Field where it would go underground to a depressed station.
Stations	
Norwalk	New elevated station.
Anaheim	New underground station, built beneath existing station.
Union Station To Irvine Station via LOSSAN	Construction of fully grade-separated tracks within existing rail corridor, to be shared by electrified and conventional trains.
Stations	
Norwalk	Existing station. Proposed improvements include bypass tracks and additional parking.
Fullerton	Existing station. Proposed improvements include bypass tracks and additional parking.
Anaheim	Existing station. Proposed improvements include bypass tracks and additional parking.
Santa Ana	Existing station. Proposed improvements include bypass tracks and additional parking.
Irvine	Existing station. Expanded platform and parking, "terminal" tracks.
CONVENTIONAL RAIL (LOSSAN CORRIDOR) & STATION OPTIONS	
Union Station To Fullerton Station 4th Main Track	Construction of fourth main track in existing rail corridor between Commerce and Fullerton. Improvements can probably be accommodated within existing LOSSAN ROW except between Rio Hondo River and San Gabriel River.
Fullerton Station To Irvine Station	
Alignment Options:	
AT-GRADE between Walnut Ave (Orange) and E. 17th St. (Santa Ana)	Grade separations at street intersections between Walnut Ave. (in Orange) and E. 17th Street in Santa Ana. At-grade curve straightening between Batavia Street and Walnut Ave. Improvements would be in existing rail corridor ROW, except for the curve realignment.
TRENCH between Walnut Ave (Orange) and E. 17th St. (Santa Ana)	Fully grade-separate existing rail corridor in a covered trench (same alignment as above), including curve straightening.
Stations	
Fullerton	Existing station. Proposed improvements include bypass tracks, platform reconfiguration, and additional parking.
Anaheim	Existing station. Proposed improvements include bypass tracks and additional parking.
Santa Ana	Existing station. Proposed improvements include bypass tracks and additional parking.
Irvine	Existing station. Proposed improvements include bypass tracks and additional parking.

[1] Conventional Rail (LOSSAN Corridor) alignment and/or construction options shown in italics and gray shading were eliminated from further evaluation during the LOSSAN Corridor Strategic Plan screening process. See text for more detail.

TABLE 1-3

Alignment and Station Options for High-Speed Train Alternative Los Angeles – Orange County – San Diego Region (continued)

Alignment Segments and Station Locations Evaluated[1]	Description of Proposed Options & Improvements
Irvine Station To San Juan Capistrano City Limits (no improvements)	No improvements are proposed for this conventional rail segment under the High-Speed Train Alternative.
San Juan Capistrano (City Limits to Avenida Aeropuerto)	
Alignments	
Covered TRENCH/Cut-Fill between Trabuco Creek and Avenida Aeropuerto (trench goes under San Juan Creek); Double tracking	*Double-tracking via an open trench along the approach to and departure from the San Juan Capistrano Station (relocated from the existing track location on the west side of the station to the east side of the station), and a covered trench under the parking area at the station. This option would include curve realignment at San Juan Creek*
TUNNEL along I-5 between Hwy 73 and Avenida Aeropuerto (tunnel under Trabuco Creek and San Juan Creek); Double tracking	Double-tracking in a tunnel running the length of the City of San Juan Capistrano under Interstate 5.
AT-GRADE and Open TRENCH along east side of Trabuco Creek	Double-tracking at grade and in an open trench along the east side of Trabuco Creek, west of the existing rail alignment.
Stations	
San Juan Capistrano	Existing station (for Covered Trench alignment only): Proposed improvements include double tracking (by-pass tracks) and parking expansion. New station would be constructed with the At-Grade/Open Trench option along Trabuco Creek. New station would be below-grade in open trench. No station would be included in San Juan Capistrano for the I-5 tunnel option.
Dana Point/San Clemente (Avenida Aeropuerto To San Onofre Power Plant)	
Alignments	
Dana Point Curve Realignment; San Clemente - SHORT TRENCH; Double Tracking	*Double-tracking and straightening existing curve at Dana Point between San Juan Creek and Avenida Aeropuerto along the existing rail corridor; double-tracking in existing rail alignment in San Clemente in a covered trench for about 1,000 feet either side of the pier.*
Dana Point Curve Realignment; San Clemente - LONG TRENCH; Double Tracking	*Double-tracking and straightening existing curve at Dana Point between San Juan Creek and Avenida Aeropuerto along the existing rail corridor; double-tracking generally along existing rail corridor through San Clemente in a covered trench from about one mile north of San Mateo Creek to about 4,000 feet north of the pier. This trench option includes one section that leaves the existing corridor and goes underneath residences located west of the corridor between the municipal pier and North El Camino Real.*
Dana Point Curve Realignment; San Clemente - SHORT TUNNEL; Double Tracking	Double-tracking and straightening existing curve at Dana Point in existing rail corridor; double-tracking via a short tunnel that follows Interstate 5 between Palm Drive and San Onofre State Beach, north of the power plant. The short tunnel alignment leaves the Interstate 5 corridor at Avenida Palizada, turns toward the coast and runs underneath residential, industrial and vacant areas, connecting with the existing rail corridor just south of Camino Capistrano.

[1] Conventional Rail (LOSSAN Corridor) alignment and/or construction options shown in italics and gray shading were eliminated from further evaluation during the LOSSAN Corridor Strategic Plan screening process. See text for more detail.

TABLE 1-3

Alignment and Station Options for High-Speed Train Alternative
Los Angeles – Orange County – San Diego Region (continued)

Alignment Segments and Station Locations Evaluated[1]	Description of Proposed Options & Improvements
San Clemente - LONG ONE-SEGMENT TUNNEL ; Double Tracking (crosses San Mateo and San Onofre Creeks)	*Double-tracking via a long, one- segment tunnel following Interstate 5 from San Onofre State Beach to Avenida Aeropuerto in San Juan Capistrano. This option precludes the need for curve realignment at Dana Point. The existing rail corridor along the coast between southern San Clemente city limits to approximately Avenida Aeropuerto in San Juan Capistrano would be removed from service (or at least not be further improved from its existing condition).*
San Clemente - LONG TWO-SEGMENT TUNNEL; Double Tracking (crosses San Mateo and San Onofre Creeks)	Double-tracking via a long, two- segment tunnel following Interstate 5 from San Onofre State Beach to Avenida Aeropuerto in San Juan Capistrano. This option precludes the need for curve realignment at Dana Point. This tunnel would have the same alignment as the one-segment long tunnel above except in a one-mile stretch near Avenida Pico, it would veer to the east edge of I-5 and daylight into an open trench for about 1,000 feet. The existing rail corridor along the coast between southern San Clemente city limits to approximately Avenida Aeropuerto in San Juan Capistrano would be removed from service (or at least not be further improved from its existing condition).
Stations	
San Clemente	The trench options for this segment would include a proposed below-grade station south of the municipal pier to replace the existing San Clemente Station. The tunnel options would eliminate the need for a train station downtown; a new below-grade station would be constructed along the tunnel alignment where the tunnel transitions to a trench.
Camp Pendleton (San Onofre Power Plant to Oceanside City Limits - Double tracking; crosses San Mateo, San Onofre, and Santa Margarita Creeks)	Construction of an at-grade second main track, in portions of this segment covering about six miles, that are not already double-tracked or will be under the conventional rail improvements included in the No-Project Alternative.
Oceanside / Carlsbad (Oceanside City Limits to Encinitas City Limits)	
Alignments	
Carlsbad - AT-GRADE; double tracking; crosses San Luis Rey, Buena Vista, Aqua Hedionda, and Batiquitos Lagoons	Double-tracking through Carlsbad in existing rail alignment at grade.
Carlsbad -TRENCH; double-tracking; crosses San Luis Rey, Buena Vista, Aqua Hedionda, and Batiquitos Lagoons	Double-tracking through Carlsbad in existing rail alignment in trench.
Stations	
Oceanside	Existing station. Proposed improvements include bypass tracks and parking expansion.

[1] Conventional Rail (LOSSAN Corridor) alignment and/or construction options shown in italics and gray shading were eliminated from further evaluation during the LOSSAN Corridor Strategic Plan screening process. See text for more detail.

TABLE 1-3

Alignment and Station Options for High-Speed Train Alternative Los Angeles – Orange County – San Diego Region (continued)

Alignment Segments and Station Locations Evaluated[1]	Description of Proposed Options & Improvements
Encinitas/Solana Beach (Encinitas City Limits to Solana Beach Station)	
Alignments	
Encinitas - AT-GRADE; Double Tracking; crosses San Elijo Lagoon	Double-tracking primarily at-grade, with a short trench segment for the rail corridor on either side of Birmingham Drive. This option would include reconfiguring the street intersection at Birmingham Drive and San Elijo Avenue, and close Chesterfield Drive at San Elijo Avenue. Another grade separation would occur at Leucadia Boulevard where the tracks would be depressed. Pedestrian undercrossings would be placed along the route.
Encinitas - SHORT TRENCH; Double Tracking; crosses San Elijo Lagoon	Double-tracking in same alignment as at-grade option above, but with an additional covered trench under Encinitas Boulevard and a transitional open trench about 1,500 feet either side of Encinitas Boulevard.
Encinitas - LONG TRENCH; Double Tracking; crosses San Elijo Lagoon	*Double-tracking in same alignment as options described above. Tracks would be in an open trench south of the Batiquitos Lagoon, then drop into a covered trench as they approach the downtown area, then return to an open trench up to the north end of the San Elijo Lagoon, where they transition to at-grade. Chesterfield Drive at San Elijo Avenue would be closed. Pedestrian crossings would be placed along the route.*
Stations	
Solana Beach	Existing station. Proposed improvements include platform modifications and parking expansion.
Del Mar(Solana Beach Station to I-5/805 Split)	
Alignments	
COVERED TRENCH on bluffs; crosses San Dieguito and Los Penasquitos Lagoons	*Double-tracking in a covered trench in the existing rail corridor alignment along the bluffs.*
TUNNEL under Camino Del Mar; crosses San Dieguito and Los Penasquitos Lagoons	Double-tracking via a tunnel underneath Camino Del Mar. Tunnel would begin at Jimmy Durante Boulevard, and daylight at Carmel Valley Road where tracks would then connect with the existing alignment across Los Penasquitos Lagoon. The existing rail track on the bluffs would be removed from service.
TUNNEL along I-5; crosses San Dieguito and Los Penasquitos Lagoons	Double-tracking via a tunnel that would run under Interstate 5 and daylight along the southern boundary of San Dieguito Lagoon. Tracks would reconnect with the existing rail at-grade near the Del Mar race track. The existing rail track on the bluffs would be removed from service.
I-5/805 Split To Hwy 52	
Alignments	
Miramar Hill Tunnel	Double-tracking via a tunnel through Miramar Hill.
I-5 Tunnel	Double-tracking via a tunnel under Interstate 5.
Stations	
UTC (Only applies to Miramar Hill Tunnel)	New station, proposed only with the Miramar Hill tunnel option. Station would be constructed underground.
Hwy 52 To Santa Fe Depot (Curve realignment; Double Tracking; San Diego River Bridge; Trench between Sassafras St and Cedar St)	Double-tracking in existing rail corridor for full length of segment. An existing curve just south of Highway 52 would be straightened, requiring two new bridges over wetlands in San Clemente Canyon. New bridges would also be constructed over Tecolote Creek and San Diego River. Tracks would be placed in a trench between Sassafras Street and Cedar Street.
Stations	
Santa Fe Depot	Existing station. Proposed improvements include bypass tracks and parking expansion.

[1] Conventional Rail (LOSSAN Corridor) alignment and/or construction options shown in italics and gray shading were eliminated from further evaluation during the LOSSAN Corridor Strategic Plan screening process. See text for more detail.

FIGURE 1-5A

High-Speed Train Alternative: Alignment and Construction Type by Segment (Los Angeles to Irvine)

FIGURE 1-5B

High-Speed Train Alternative: Alignment and Construction Type by Segment (Irvine to Oceanside)

FIGURE 1-5C

High-Speed Train Alternative: Alignment and Construction Type by Segment (Oceanside to San Diego)

2.0 BASELINE/AFFECTED ENVIRONMENT

2.1 STUDY AREA

The Study Area for hydrology and water quality is defined as: (1) a 100-foot zone from the centerline of the High-Speed Train Alternative's proposed alignments and the direct footprint of new station facilities, including a 100-foot zone from new station facilities; and (2) a 100-foot zone from the Modal Alternative's direct corridor footprint and/or direct footprint of facilities, including corridors and facilities that would undergo upgrades/expansions.

2.2 REGULATORY ENVIRONMENT

2.2.1 Federal Regulations

Clean Water Act of 1977 and 1987

The purpose of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the nation's waters through prevention, and elimination of pollution. It is applicable to any discharge of a pollutant into waters of the United States. Key sections of the CWA include:

1. Section 404 permit for dredge or fill materials from U.S. Army Corps of Engineers.
2. Section 402 permits (National Pollutant Discharge Elimination System [NPDES] permit) for all other discharges are obtained from U.S. Environmental Protection Agency (EPA) or appropriate state agency, which in most cases is the appropriate Regional Water Quality Control Board (RWQCB).
3. Section 401 water quality certification is required from the appropriate RWQCBs.
4. All projects must be consistent with the state Non-point Source Pollution Management Program (Section 319).

<u>Section 401 (33 U.S.C. 1341 and 40 CFR 121)</u>: Section 401 of the CWA requires a water quality certification from the State Water Resources Control Board (SWRCB) or RWQCBs when a project:

1. Requires a federal license or permit (a Section 404 permit is the most common federal permit for highway or rail projects), and
2. Will result in a discharge to waters of the United States. Such certification may be conditioned. Project activities that typically result in a discharge subject to Section 401 water quality certification are the construction and subsequent operation of a facility.

The SWRCB revised the state regulations for the 401 Water Quality Certification Program. These revisions went into effect on June 24, 2000. The likelihood of a passive waiver has been reduced by the revised regulations that certification must be issued or denied before any federal deadline.

<u>Section 402 (33 U.S.C. 1342 and 40 CFR 122)</u>: This section of the CWA establishes a permitting system for the discharge of any pollutant (except dredge or fill material) into waters of the United States. A National Pollutant Discharge Elimination System (NPDES) permit is required for all point discharges of pollutants to surface waters. A point source is a discernible, confined, and discrete conveyance, such as by pipe, ditch, or channel.

<u>Section 404 (33 U.S.C. 1344, 33 CFR Part 323, and 40 CFR Part 230)</u>: Section 404 of the CWA establishes a permit program administered by the U.S. Army Corps of Engineers (ACOE), which regulates the discharge of dredged or fill material into waters of the United States (including wetlands). The

Section 404(b)(1) guidelines allow the discharge of dredged or fill material into the aquatic system only if there is no practicable alternative that would have less adverse impacts.

Wild and Scenic Rivers Act of 1968, as Amended
(16 U.S.C. 1271-1287; 36 CFR251, 297; 43 CFR 8350)
The purpose of the Wild and Scenic Rivers Act is to preserve and protect wild and scenic rivers and immediate environments for benefit of present and future generations. It is applicable to all projects which affect designated wild, scenic, and recreational rivers and immediate environment and rivers under study for inclusion into the system. The Act prohibits federal agencies from undertaking activities that would adversely affect the values for which the river was designated. The Act is administered by a variety of state and federal agencies. Designated river segments flowing through federally managed lands are administered by the land-managing agency (e.g., U.S. Forest Service, Bureau of Land Management and the National Park Service). River segments flowing through private lands are administered by the state in conjunction with local government agencies. On projects that affect designated rivers or their immediate environments, consultation will occur through the NEPA process between the state lead agency and the land-managing agencies.

Safe Drinking Water Act of 1944, as Amended (42 U.S.C. 300[f])
The purpose of the Safe Drinking Water Act is to ensure public health and welfare through safe drinking water. The Act is applicable to all public drinking water systems and reservoirs (including rest area facilities). It is also applicable to actions that may have a significant impact on an aquifer or wellhead protection area that is the sole or principal drinking water. This act requires coordination with EPA when an area designated as a principal or sole source aquifer may be impacted by a proposed project. In California, the EPA has designated the following as sole source aquifers: Campo-Cottonwood, Fresno, Ocotillo-Coyote Wells, Santa Margarita, and Scotts Valley.

Executive Order 11988 – Floodplain Management
(U.S. DOT Order 5650.2; 23 CFR 650, Subpart A)
Executive Order 11988 directs all federal agencies to avoid all short-term and long-term adverse impacts associated with floodplain modification and to avoid direct and indirect support of development within 100-year floodplains whenever there is a reasonable alternative available.

Projects that encroach upon 100-year floodplains must be supported with additional specific information. The U.S. Department of Transportation Order 5650.2, titled "Floodplain Management and Protection," prescribes "policies and procedures for ensuring that proper consideration is given to the avoidance and mitigation of adverse floodplain impacts in agency actions, planning programs and budget requests." The order does not apply to areas with Zone C (areas of minimal flooding as shown on Federal Emergency Management Agency [FEMA] Flood Insurance Rate Maps [FIRM]). The order requires that attention be given and findings made in environmental review documents indicating any risks, impacts, and support from the proposed transportation facility.

Flood Disaster Protection Act
(42 U.S.C. 4001-4128; DOT Order 5650.2, 23 CFR 650 Subpart A; and 23 CFR 771)
The purpose of the Flood Disaster Protection Act is to identify flood-prone areas and provide insurance. The Act requires purchase of insurance for buildings in special flood-hazard areas. The Act is applicable to any federally assisted acquisition or construction project in an area identified as having special flood hazards. Projects should avoid construction in, or develop a design to be consistent with, FEMA-identified flood-hazard areas.

2.2.2 State Regulations

California Department of Fish and Game
(Sections 1601-1603 [Streambed Alteration])
Under Sections 1601-1603 of the Fish and Game Code, agencies are required to notify the California Department of Fish and Game (CDFG) prior to any project which would divert, obstruct or change the natural flow or bed, channel or bank of any river, stream or lake. Preliminary notification and project review generally occurs during the environmental process. When an existing fish or wildlife resource may be substantially adversely affected, the CDFG is required to propose reasonable project changes to protect the resource. These modifications are formalized in a "streambed alteration agreement" which becomes part of the plans, specifications and bid documents for a project.

Porter-Cologne Water Quality Act
(Water Code sections 13000 et seq.)
The Porter-Cologne Act is the basic water quality control law for California. The act is implemented by the SWRCB and the nine RWQCBs. The boards implement the permit provisions (Section 402), certain planning provisions (sections 205, 208, and 303 of the federal CWA). This means that the state issues one discharge permit for purposes of both state and federal law. Under state law, the permit is officially called waste discharge requirement. Under federal law, the permit is officially called a NPDES permit. The Porter-Cologne Act requires that anyone who is discharging waste or proposing to discharge waste that could affect the quality of the state's water must file a "report of waste discharge" with that RWQCB.

2.2.3 Other Regulations

The California Regional Water Quality Control Boards (RWQCB) work with the State Water Resources Control Board to preserve and enhance the quality of California's water resources for the benefit of present and future generations. Nine part-time members who are each appointed by the Governor govern the RWQCBs. The RWQCBs hold hearings on, among other issues, waste discharge permits, enforcement actions, and basin plan amendments. The proposed project area encompasses the following Regional Water Quality Control Boards: Region 4 (Los Angeles), Region 8 (Santa Ana), and Region 9 (San Diego).

2.3 BASELINE / AFFECTED ENVIRONMENT

2.3.1 Floodplains

In support of the National Flood Insurance Program (NFIP), FEMA has undertaken a massive effort of flood hazard identification and mapping to produce Flood Hazard Boundary Maps, Flood Insurance Rate Maps, and Flood Boundary and Floodway Maps. Flood zones in the study area are shown in Figure 2-1. The zone of interest in this program-level evaluation is defined as follows: Zone A or Special Flood Hazard Area (SFHA) - the flood insurance rate zone that corresponds to the magnitude of flooding having a one percent chance to occur in any given year (100-year flood) FEMA chose the annual chance standard after considering various alternatives. The standard constitutes a reasonable compromise between the need for building restrictions to minimize potential loss of life and property and the economic benefits to be derived from floodplain development. Development may take place within the SFHA, provided that development complies with local floodplain management ordinances, which must meet the minimum Federal requirements. Flood insurance is required for insurable structures within the SFHA to protect federally funded or federally backed investments and assistance used for acquisition and/or construction purposes within communities participating in the NFIP.

FIGURE 2-1

2.3.2 Surface Waters

Rivers and streams represent the major watercourses that flow through and drain their respective watersheds. A watershed is the geographic area draining into a river system, ocean or other body of water through a single outlet and includes the receiving waters. Watersheds are usually bordered, and separated from other watersheds, by mountain ridges or other naturally elevated areas. Natural watercourses are complex ecosystems which include the land, plants, animals, and network of streams. They perform a number of ecological functions such as modulating stream flow, storing water, removing harmful materials from water, and providing habitat for aquatic and terrestrial plants and animals. Stream corridors also have vegetation and soil characteristics distinctly different from surrounding uplands and support higher levels of species diversity, species densities, and rates of biological productivity than most other landscape elements. In urbanized areas, rivers have been highly modified with dams and concrete channeling resulting in a loss of habitat and human access to the rivers. Urban activities such as groundwater recharge, significant discharges of wastewaters including sewage treatment plant reclaimed waters, and point and non-point source runoff have significantly changed the natural hydrology of the rivers.

Lakes are large bodies of freshwater that receive rivers or from which rivers flow. Lagoons and estuaries are sheltered, semi-enclosed, brackish bodies of water along the shore where fresh water and salt water interface through tidal flows and currents. They include the mouths of rivers, bays, and the sheltered waters between barrier islands and the mainland. Lagoons are shallower than estuaries, with hardly any tidal flow. The amount of freshwater influx and the quality, frequency and duration of flow establish salinity levels, which in turn dictate the types of biota associated with the particular water body. Lagoons and estuaries are highly productive biologically. Pollution from stormwater runoff, industrial discharges, and boats can severely damage estuaries and lagoons because of their lack of tidal flow.

Table 2-1 lists the major surface bodies of waters within the 100-foot study area for the alternatives. Lakes and lagoons are grouped into one category and rivers and streams are grouped in the second category. Table 2-1 identifies the major bodies of water and does not account for the associated tributaries and any unnamed blueline streams that may also be located within the study area. Additional surface waters would be identified and addressed at the project level in Tier 2.

TABLE 2-1

Surface Waters

Study Area Segment	Lakes/Lagoons	Rivers/Streams
NO-PROJECT		
N/A	N/A	N/A
MODAL		
Union Station to Fullerton Station	N/A	Rio Hondo River San Gabriel River Coyote Creek Fullerton Creek
Fullerton Station to Irvine Station	N/A	Carbon Creek Santa Ana River Santiago Creek Peters Canyon Wash (tributary to San Diego Creek)
Irvine Station to San Juan Capistrano City Limits	N/A	Oso Creek (parallels track)
San Juan Capistrano	N/A	Oso Creek (parallels track) Trabuco Creek San Juan Creek
Dana Point and San Clemente	N/A	San Mateo Creek San Onofre Creek
Camp Pendleton	N/A	Santa Margarita River
Oceanside and Carlsbad	Buena Vista Lagoon Agua Hedionda Lagoon Batiquitos Lagoon	San Luis Rey River Loma Alta Creek Batiquitos Lagoon (San Marcos River)
Encinitas and Solana Beach	San Elijo Lagoon	San Elijo Lagoon (Escondido Creek, Orilla Creek)
Del Mar	San Dieguito Lagoon	San Dieguito River
I-5/805 split to Highway 52	N/A	Los Penasquitos Canyon Creek Soledad Creek
Highway 52 to Santa Fe Depot	San Diego Bay Mission Bay	Tecolote Creek San Diego River
HIGH-SPEED RAIL CORRIDOR		
LAX to Union Station	N/A	Los Angeles River (parallels track south of Union Station)
Union Station to Anaheim Station via UPRR Corridor	N/A	Los Angeles River Rio Hondo River San Gabriel River Coyote Creek Fullerton Creek Carbon Creek Santa Ana River

TABLE 2-1

Surface Waters (continued)

Study Area Segment	Lakes/Lagoons	Rivers/Streams
Union Station to Irvine Station via LOSSAN Corridor	N/A	Los Angeles River Rio Hondo River San Gabriel River Coyote Creek La Mirada Creek Brea Creek Fullerton Creek Carbon Creek Santa Ana River Santiago Creek Peters Canyon Wash (tributary to San Diego Creek)
CONVENTIONAL RAIL (LOSSAN CORRIDOR)		
Union Station to Fullerton Station	N/A	Los Angeles River Rio Hondo River San Gabriel River Coyote Creek La Mirada Creek Brea Creek
Fullerton Station to Irvine Station	N/A	Fullerton Creek Carbon Creek Santa Ana River Santiago Creek Peters Canyon Wash/San Diego Creek (tributary to San Diego Creek)
San Juan Capistrano	N/A	Oso Creek (parallels track) Trabuco Creek San Juan Creek
Dana Point	N/A	San Juan Creek San Mateo Creek San Onofre Creek
Camp Pendleton	N/A	Santa Margarita River
Oceanside and Carlsbad	Buena Vista Lagoon Agua Hedionda Lagoon Batiquitos Lagoon	San Luis Rey River Loma Alta Creek Batiquitos Lagoon (San Marcos River)
Encinitas and Solana Beach	San Elijo Lagoon	San Elijo Lagoon (Escondido Creek, Orilla Creek)
Del Mar	San Dieguito Lagoon Los Penasquitos Lagoon	San Dieguito River Soledad Creek (Los Penasquitos River)
I-5/805 split to Highway 52	N/A	Soledad Creek (Los Penasquitos River) Los Penasquitos Canyon Creek
Highway 52 to Santa Fe Depot	Mission Bay San Diego Bay	Tecolote Creek San Diego River

Source: Thomas Bros. Maps (Los Angeles/Orange Counties, 1998; San Diego County, 2003); USGS, 1990.

The LOSSAN rail corridor crosses six major lagoons, as shown in Table 2-1. A description of these lagoons and the current or planned enhancement/restoration plans for them are described in a separate technical report for this project. (Refer to *Los Angeles – Orange County – San Diego Region Biological Resources Technical Evaluation, April 2003*.)

CWA 303(d) IMPAIRED WATERS

Section 303(d) of the Clean Water Act (CWA) requires each state to identify waters that will not achieve water quality standards after application of effluent limits and to develop plans for cleaning them up. For each water and pollutant, the state is required to propose a priority for development of load-based (as opposed to concentration-based) limits called total maximum daily loads (TMDLs). The TMDL determines how much of a given pollutant can be discharged from a particular source without causing water quality standards to be violated. Priorities for development of TMDLs are set by the state, based on the severity of the pollution and uses of the waters. Effluent limits in NPDES permits (administered by the RWQCBs) must be consistent with such wasteload allocations. The EPA-issued TMDL Program provides a process for determining pollution budgets for the nation's waters. The Program includes development of water quality standards, issuance of permits to control discharges, and enforcement against violators.

The study area encompasses the following RWQCBs: Region 4 (Los Angeles), Region 8 (Santa Ana), and Region 9 (San Diego). Table 2-2 and Figure 2-2 identify surface waters (lakes/lagoons and rivers/ streams) on the Los Angeles, Orange, and San Diego RWQCB's 1998 303(d) List, and TMDL Priorty Schedule.

Table 2-2
303(d) Impaired Waters in the Study Area

Los Angeles County	Orange County	San Diego County
Los Angeles River (Reach 1-6) Rio Hondo River (Reach 1-2) San Gabriel River (Reach 1-3) Coyote Creek	Santa Ana River (Reach 1-4) Santiago Creek Peters Canyon Wash (tributary to San Diego Creek) San Juan Creek (mouth and lower)	Santa Margarita (lagoon) River Loma Alta Creek (slough) Buena Vista Lagoon Agua Hedionda Lagoon Batiquitos Lagoon/San Marcos River San Luis Rey River San Elijo Lagoon San Dieguito Lagoon Los Penasquitos Lagoon Mission Bay Tecolote Creek San Diego Bay

Source: Los Angeles, Orange, and San Diego RWQCB's 1998 303(d) List and TMDL Priorty Schedule.

The rivers and streams are considered impaired because they exceed standards for algae, ammonia, metals, coliform count, pesticides, nutrients, toxicity, trash, and/or sedimentation. Sources of the pollutants/stressors include nonpoint and point sources, urban runoff, storm sewers, agriculture, erosion/ siltation, and construction/land development.

FIGURE 2-2

Loma Alta Creek (slough), Buena Vista, Agua Hedionda, San Elijo, and Los Penasquitos Lagoons are identified as esturaries. Batiquitos (San Marcos River) and San Dieguito Lagoons are identified as coastal shoreline waterbody types and are considered as impaired for the purpose of this analysis. These lagoons range in size from approximately 220 to 640 acres in size. In general, these lagoons are considered impaired due to declining water quality, increased freshwater input, accumulated sediment, diminished biological productivity, and water circulation constraints. Loma Alta Creek (slough), Buena Vista, Agua Hedionda , San Dieguito, San Elijo and Batiquitos Lagoons are also listed for exceeding standards for nutrients and coliform bacteria.

2.3.3 Erosion

Soils exposed during site preparation would be subject to erosion. A potential erosive condition is identified as those areas with a combination of erosive soils and high slopes. The slope and erodibility were extracted for each soil type based upon the State Soil Geographic (STATSGO) database and evaluated as the product of "kfact" and "slopeh". "Kfact" designates the soil erodibility factor (including rock fragments) and "slopeh" indicates the soil slope. Those conditions where the product of "kfact" and "slopeh" is greater than 3.0 are considered to be potentially susceptible to erosion. Soils within the study area identified with a factor greater that 3.0 are shown in Figure 2-3.

2.3.4 Groundwater

Geohydrology

The hydrogeologic setting for the regional basins is mostly comprised of freshwater contained in aquifers that consist of continental deposits of sand and gravel that might be interbedded with confining units of fine-grained material, such as silt and clay. The aquifers and confining units compose an aquifer system. Water enters a typical coastal-basin aquifer in several ways. Runoff from precipitation in the surrounding mountains infiltrates the permeable sediments of the valley floor either at the basin margins or through streambeds where the water table is lower than the water level in the stream. Precipitation that falls on the valley floor provides some direct recharge, but in the coastal basins, most of the precipitation evaporates or is transpired by plants. In a few basins that are hydraulically connected to other basins, water can enter an aquifer system as lateral subsurface flow from an adjacent basin. Of these methods of recharge, runoff from the mountains and percolation through streambeds provide the largest amounts of water to the ground-water system.

Natural movement of water in the aquifers is generally parallel to the long axis of the basin because of impermeable rocks that commonly form a barrier between the basin and the sea. However, in a few coastal basins, the coastal barrier is absent, and the natural direction of flow is perpendicular to the long axis of the basin or from the inland mountains to the sea. Before major development, ground water in all the basins discharged directly into the ocean or into bays connected to the ocean. After development, however, most or all the ground water is withdrawn by wells in the basins.

Groundwater

Groundwater is of concern where it might occur near areas that could impact a groundwater basin's water quality. Groundwater is defined as subsurface water that occurs beneath the water table in soils and geologic formations that are fully saturated. Where groundwater occurs in a saturated geologic unit that contains sufficient permeable thickness to yield significant quantities of water to wells and springs, it can be defined as an aquifer. A groundwater basin is defined as a hydrogeologic unit containing one large aquifer or several connected and interrelated aquifers. Groundwater may also occur outside of the identified basins for this proposed project. Unless otherwise designated by the RWQCB, all groundwater is considered suitable, or potentially suitable, for municipal or domestic water supply.

FIGURE 2-3

The proposed project study area has one major aquifer within the 100-foot buffer zone of the defined right-of-way limits/High-Speed Train Alternative centerline and boundaries of associated facilities. The California Coastal Basin Aquifer (CCBA) was the only principal aquifer identified (Figure 2-4). This aquifer consists primarily of basin-fill deposits that occupy structural depressions caused by deformation of the Earth's crust from folding and faulting. The CCBA is filled with marine and alluvial sediments and is drained by streams that contain water at least part of the year. Specifically, the valleys that contain the CCBA are formed by structural troughs that are typically filled with thousands of feet of marine and continential sediments. As discussed the natural groundwater flow for the CCBA follows the axis of the troughs in the majority of the valleys. Recharge to the aquifers is mainly through precipitation that runs off from the surrounding mountains and infiltrates through streambeds and/or by direct rainfall to the valley floor. The available groundwater is used primarily for municipal supplies, but with local groundwater supplies at levels that are considered inadequate, surface water must be transported from a distant source to meet the demand.

Additional aquifers within the 100-foot buffer zone were not identified by name but the presence was acknowledged in the database. The groundwater basins in the project area that produce or potentially could produce significant amounts of water and associated groundwater basin elevations would be identified and addressed in the project level at Tier 2.

2.3.5 Sea Level Rise

The characteristic of the coastline is dependent upon various natural processes, of which global warming and rising sea levels has become a growing concern as a coastal hazard and an economic and geographic hazard to coastal communities. It is projected that a rise of 19 inches (with a possible range of 5 to 37 inches) in sea level could occur by the year 2100. A rise in sea level would expose the coastline to increased flooding. Ocean temperatures are expected to continue to rise but the rate of increase is likely to lag behind the changes in temperature on land. Increased temperature or decreased salinity as well as an increase in carbon dioxide levels could lead to changes in thermohaline ocean circulation as well as coastal and marine resources. Geology and hydrology define the coastal landforms with the size of bays and shoreline migration. Seasonal changes with storms, ocean currents and climate such as El Nino events create impacts on the coastline. Sediment runoff from rivers and streams as well as precipitation intensity would alter the amount and behavior of transported sediments.

FIGURE 2-4

3.0 METHODOLOGY FOR IMPACT EVALUATION

The methodology employed for impact evaluation consists of a combination of both qualitative and quantitative assessment. A qualitative assessment was used for general comparisons of the three alternatives, on a segment-by-segment basis, when discussing issues such as runoff rates, sedimentation or other items that require a more detailed approach than what is warranted for this document. Based on each alternative, general conclusions are generated to support the relative change in impact between the alternatives. The No-Project Alternative is the primary basis of comparison. The impacts as a result of the Modal and High-Speed Train Alternatives are characterized as High, Medium or Low as compared to the No-Project Alternative.

A high impact to hydrology and/or water quality would generally be defined as the following:

- Proposed project will result in a substantial encroachment on a floodplain as defined in Executive Order 11998 for Floodplain Management (40 CFR 6.302[a]), or is located in a 100-year floodplain without adequate mitigation measures.
- Proposed project will result in violations of federal, state, or local water quality standards, or will contribute to violation when evaluated cumulatively with other projects in the region.
- Provisions to prevent contamination of surface waters and/or aquifers are not adopted as a part of the proposed project.
- Proposed project will result in substantial alteration in hydrology, including increased stormwater runoff, or increased groundwater discharge or reduction of groundwater recharge.

For medium or low impacts, the results are proportionately less for the hydrology and water quality information presented above. Additional potential impacts to hydrology and water quality include increased/decreased runoff and stormwater discharge from alteration in the amount of paved surfaces, increased or decreased contribution of automotive-based non-point source contamination, impacts on areas of groundwater discharge or infiltration.

For the quantitative assessment, readily available information such as wetland areas, stream locations, impacts on areas with existing water quality problems, flood zones, and soil information is used to assess the magnitude of the impact. For the purposes of this analysis, the study area is defined to include the following: (1) for the High-speed Train Alternative, direct corridors proposed for alternative alignments, including up to a 100-foot buffer from the corridors, the direct footprint of new station facilities, including a 100-foot buffer from new station facilities; and (2) for the Modal Alternative, direct corridors for facilities which would undergo upgrades, including up to a 100-foot buffer from the upgraded facilities.

The quantitative evaluation of potential impacts to water quality from the proposed High-Speed Train and Modal alternatives consists of the following analyses:

- The acreage of floodplains defined as Special Flood Hazard Areas (SFHAs) (as defined by the FEMA on FIRMs) within the study area was determined.
- The acreage of surface waters (lakes or lagoons) or linear feet (rivers or streams) within the study area was determined. Surface waters are defined as lakes, lagoons, rivers, and streams as identified on U.S. Geological Survey (USGS) 1:24,000 scale digital line graphs (DLGs). The linear feet of surface water was calculated based on the flow-path length of rivers and streams within the study area. Lake surface areas represent the impoundment at maximum capacity.

- The location of impaired waters defined as waters identified on the CWA 303(d) list (as distributed by the SWRCB) within the study area was determined.

- Potential erosive conditions were identified as those areas with a combination of erosive soils and steep slopes, evaluated as the product of "kfact" and "slopeh" (listed in the STATSGO database). Those conditions where "kfact" multiplied by "slopeh" is greater than 3.0 are considered susceptible to erosion. Table 4-1 (Chapter 4) indicates the approximate acres of soil within the buffer area of a segment having an erosion value greater than 3.0. For Table 1-4 (Chapter 1), the total acreage within a segment having a value of greater than 3.0, divided by the total acres within the segment, produced a percentage of the segment that is susceptible to erosion. This percentage was compared to predetermined ranges with value ratings of high, medium, and low. The range of values are: 0% - 10% = Low; 10% - 25% = Medium; and >25% = High. The ratings are shown in Table 1-4.

4.0 HYDROLOGY AND WATER QUALITY IMPACTS

The following hydrologic impacts were considered most important when comparing High-Speed Train and Modal Alternatives:

- Potential damage to infrastructure improvements due to flooding;
- Amount of pollutants entering surface water bodies and groundwater from construction and operational activities;
- Soils that are susceptible to erosion;
- Ground water degradation through storm water run-off and saltwater intrusion; and,
- Potential to impede tidal flow at major lagoon crossings.

Table 4-1 provides a comparative analysis of resources potentially affected by the alternatives. Key issues for each of the alternatives are further described at the end of this section.

TABLE 4-1

Analysis/Comparison Table
Impacts to Hydrology & Water Quality
Los Angeles - Orange County - San Diego

	Floodplains[1] (acres)	Surface Waters (acres/feet)	303 (d) Impaired Waters[2]	Erosion (acres)	Groundwater (H,M,L)
NO-PROJECT ALTERNATIVE	The No-Project Alternative would involve construction of highway and rail improvement projects programmed for completion between now and 2020 (refer to Table 1-1). All potential hydrology and water quality impacts resulting from the No-Project Alternative would be addressed and evaluated in associated environmental documents at a project level. Under the No-Project Alternative, no additional, direct hydrological and water quality impacts would occur beyond those addressed in environmental documents for those projects. The No-Project Alternative would not provide any opportunity for long-term solutions to the continued erosion problems along the existing rail corridor in the San Clemente and Del Mar areas, caused by wave action, groundwater infiltration, and slope stability. The bluffs would need to be stabilized over the long-term, and drainage facilities maintained or increased, in order to continue reliable rail service in these areas.				
MODAL ALTERNATIVE					
Union Station to LAX	There are no Modal improvements proposed for this segment.				
Union Station To Fullerton Station	0	Lakes/Lagoons = 0 ac. Rivers/Streams = 835 ft.	Rio Hondo River San Gabriel River Coyote Creek	95	L
Fullerton Station To Irvine Station	115	Lakes/Lagoons = 0 ac. Rivers/Streams = 575 ft.	Santa Ana River Santiago Creek Peters Canyon Wash (tributary to San Diego Creek)	0	L
Irvine Station To San Juan Capistrano City Limits	20	Lakes/Lagoons = 0 ac. Rivers/Streams = 1,630 ft.	None	200	L
San Juan Capistrano	10	Lakes/Lagoons = 0 ac. Rivers/Streams = 1,700 ft.	San Juan Creek (lower)	35	L
Dana Point/San Clemente	0	Lakes/Lagoons = 0 ac. Rivers/Streams = 745 ft.	None	250	L

TABLE 4-1

Analysis/Comparison Table
Impacts to Hydrology & Water Quality
Los Angeles - Orange County - San Diego (continued)

	Floodplains[1] (acres)	Surface Waters (acres/feet)	303 (d) Impaired Waters[2]	Erosion (acres)	Groundwater (H,M,L)
Camp Pendleton	0	Lakes/Lagoons = 0 ac. Rivers/Streams = 940 ft.	Santa Margarita River[3]	205	L
Oceanside/Carlsbad	15	Lakes/Lagoons = 7 ac. Rivers/Streams = 660 ft.	Buena Vista Lagoon[3,4] Agua Hedionda Lagoon[3] Batiquitos Lagoon/San Marcos River[4] San Luis Rey River[4]	210	L
Encinitas/Solana Beach	5	Lakes/Lagoons = 5 ac. Rivers/Streams = 125 ft.	San Elijo Lagoon[3]	140	L
Del Mar	30	Lakes/Lagoons = 0 ac. Rivers/Streams = 320 ft.	San Dieguito Lagoon[4]	130	L
I-5/805 Split To Hwy 52	10	Lakes/Lagoons = 0 ac. Rivers/Streams = 300 ft.	None	35	L
Hwy 52 To Santa Fe Depot	5	Lakes/Lagoons = 0 ac. Rivers/Streams = 425 ft.	Mission Bay Tecolote Creek San Diego Bay	130	L
HIGH-SPEED TRAIN ALTERNATIVE					
High-Speed Rail					
LAX To Union Station	5	Lakes/Lagoons = 0 ac. Rivers/Streams = 1,300 ft.	Los Angeles River (parallels track south of Union Station)	210	L for at-grade and elevated sections; M for trenched sections
Stations					
LAX	0	None	None	5	H

TABLE 4-1

Analysis/Comparison Table
Impacts to Hydrology & Water Quality
Los Angeles - Orange County - San Diego (continued)

	Floodplains[1] (acres)	Surface Waters (acres/feet)	303 (d) Impaired Waters[2]	Erosion (acres)	Groundwater (H,M,L)
Union Station To Anaheim Station via UPRR	15	Lakes/Lagoons = 0 ac. Rivers/Streams = 650 ft.	Los Angeles River Rio Hondo River San Gabriel River Coyote Creek Santa Ana River	0	L for at-grade and elevated sections; M for trenched and tunneled sections.
Stations					
Norwalk	0	None	None	0	L
Anaheim	0	None	None	0	H
Union Station To Irvine Station via LOSSAN	75	Lakes/Lagoons = 0 ac. Rivers/Streams = 3,265 ft.	Los Angeles River Rio Hondo River San Gabriel River Coyote Creek Santa Ana River Santiago Creek Peters Canyon Wash (tributary of San Diego Creek)	240	L for at-grade sections; M for trenched section between Anaheim and Irvine
Stations					
Norwalk	0	None	None	0	L
Fullerton	0	None	None	15	L
Anaheim	15	None	None	0	L
Santa Ana	0	None	None	0	L
Irvine	5	None	None	0	L

TABLE 4-1

Analysis/Comparison Table
Impacts to Hydrology & Water Quality
Los Angeles - Orange County - San Diego (continued)

	Floodplains[1] (acres)	Surface Waters (acres/feet)	303 (d) Impaired Waters[2]	Erosion (acres)	Groundwater (H,M,L)
Conventional Rail					
Union Station To Fullerton Station (4th main track)	10	Lakes/Lagoons = 0 ac. Rivers/Streams = 675 ft.	Los Angeles River Rio Hondo River San Gabriel River Coyote Creek	220	L
Fullerton Station To Irvine Station					
Alignments					
AT-GRADE between Walnut Ave (Orange) and E. 17th St. (Santa Ana)	65	Lakes/Lagoons = 0 ac. Rivers/Streams = 2,590 ft.	Santa Ana River Santiago Creek Peters Canyon Wash (tributary to San Diego Creek)	20	L
TRENCH between Walnut Ave (Orange) and E. 17th St. (Santa Ana)	65	Lakes/Lagoons = 0 ac. Rivers/Streams = 2,590 ft.	Santa Ana River Santiago Creek Peters Canyon Wash (tributary to San Diego Creek)	20	L for at-grade sections; M for trenched section between Anaheim and Irvine
Stations					
Fullerton	0	None	None	15	L
Anaheim	15	None	None	0	L
Santa Ana	0	None	None	0	L
Irvine	5	None	None	0	L
Irvine Station To San Juan Capistrano City Limits (no improvements)	There are no Conventional Rail improvements proposed for this segment.				

TABLE 4-1

Analysis/Comparison Table
Impacts to Hydrology & Water Quality
Los Angeles - Orange County - San Diego (continued)

	Floodplains[1] (acres)	Surface Waters (acres/feet)	303 (d) Impaired Waters[2]	Erosion (acres)	Groundwater (H,M,L)
San Juan Capistrano (City Limits to Avenida Aeropuerto)					
Alignments					
Covered TRENCH/Cut-Fill between Trabuco Creek and Avenida Aeropuerto (trench goes under San Juan Creek); Double tracking	20	Lakes/Lagoons = 0 ac. Rivers/Streams = 820 ft.	San Juan Creek (lower)	30	L for at-grade sections; M for trenching sections
TUNNEL along I-5 between Hwy 73 and Avenida Aeropuerto (tunnel under Trabuco Creek and San Juan Creek); Double tracking	25	Lakes/Lagoons = 0 ac. Rivers/Streams = 1,195 ft.	San Juan Creek (lower)	35	L in at-grade sections; M with the tunnel leaving CCBA
AT-GRADE and Open TRENCH along east side of Trabuco Creek	5	Lakes/Lagoon = 0 ac. Rivers/Streams = 2,340 ft.	None	5	L
Stations					
San Juan Capistrano	0	None	None	0	L
Dana Point/San Clemente (Avenida Aeropuerto To San Onofre Power Plant)					
Alignments					
Dana Point Curve Realignment; San Clemente - SHORT TRENCH; Double Tracking (crosses San Mateo and San Onofre Creeks)	45	Lakes/Lagoons = 0 ac. Rivers/Streams = 645 ft.	None	130	L in at-grade sections; M in trench sections

TABLE 4-1

Analysis/Comparison Table
Impacts to Hydrology & Water Quality
Los Angeles - Orange County - San Diego (continued)

	Floodplains[1] (acres)	Surface Waters (acres/feet)	303 (d) Impaired Waters[2]	Erosion (acres)	Groundwater (H,M,L)
Dana Point Curve Realignment; San Clemente - LONG TRENCH; Double Tracking (crosses San Mateo and San Onofre Creeks)	45	Lakes/Lagoons = 0 ac. Rivers/Streams = 645 ft.	None	130	L in at-grade sections; M in trench sections
Dana Point Curve Realignment; San Clemente - SHORT TUNNEL; Double Tracking (crosses San Mateo and San Onofre Creeks)	30	Lakes/Lagoons = 0 ac. Rivers/Streams = 740 ft.	None	235	L in at-grade sections; M in trench sections
San Clemente - LONG ONE-SEGMENT TUNNEL; Double Tracking (crosses San Mateo and San Onofre Creeks)	0	Lakes/Lagoons = 0 ac. Rivers/Streams = 340 ft.	None	240	M in trench sections; tunnel is not within the CCBA
San Clemente - LONG TWO-SEGMENT TUNNEL; Double Tracking (crosses San Mateo and San Onofre Creeks)	0	Lakes/Lagoons = 0 ac. Rivers/Streams = 340 ft.	None	240	M for trench sections; tunnel is not within the CCBA
Stations					
San Clemente	5	0	None	0	L
Camp Pendleton (San Onofre Power Plant to Oceanside City Limits - Double tracking; crosses Santa Margarita River)	0	Lakes/Lagoons = 0 ac. Rivers/Streams = 940 ft.	Santa Margarita River[3]	0	L

TABLE 4-1

Analysis/Comparison Table
Impacts to Hydrology & Water Quality
Los Angeles - Orange County - San Diego (continued)

	Floodplains[1] (acres)	Surface Waters (acres/feet)	303 (d) Impaired Waters[2]	Erosion (acres)	Groundwater (H,M,L)
Oceanside/Carlsbad (Oceanside City Limits to Encinitas City Limits)					
Alignments					
Carlsbad - AT-GRADE; double tracking; crosses San Luis Rey, Buena Vista , Aqua Hedionda, and Batiquitos Lagoons	15	Lakes/Lagoons = 7 ac. Rivers/Streams = 1,300 ft.	Loma Alta Creek (slough)[3] Buena Vista Lagoon[3,4] Agua Hedionda Lagoon[3] Batiquitos Lagoon/San Marcos River[4] San Luis Rey River[4]	95	L
Carlsbad -TRENCH; double-tracking; crosses San Luis Rey, Buena Vista, Aqua Hedionda, and Batiquitos Lagoons	15	Lakes/Lagoons = 7 ac. Rivers/Streams = 1,300 ft.	Loma Alta Creek (slough)[3] Buena Vista Lagoon[3,4] Agua Hedionda Lagoon[3] Batiquitos Lagoon/San Marcos River[4] San Luis Rey River[4]	95	L trenching not in CCBA
Stations					
Oceanside	0	None	None	5	L
Encinitas/Solana Beach (Encinitas City Limits to Solana Beach Station)					
Alignments					
Encinitas - AT-GRADE; Double Tracking; crosses San Elijo Lagoon	20	Lakes/Lagoons = 3 ac. Rivers/Streams = 1,615 ft.	San Elijo Lagoon[3]	160	L
Encinitas - SHORT TRENCH; Double Tracking; crosses San Elijo Lagoon	20	Lakes/Lagoons = 3 ac. Rivers/Streams = 1,615 ft.	San Elijo Lagoon[3]	160	M

TABLE 4-1

Analysis/Comparison Table
Impacts to Hydrology & Water Quality
Los Angeles - Orange County - San Diego (continued)

	Floodplains[1] (acres)	Surface Waters (acres/feet)	303 (d) Impaired Waters[2]	Erosion (acres)	Groundwater (H,M,L)
Encinitas - LONG TRENCH; Double Tracking; crosses San Elijo Lagoon	20	Lakes/Lagoons = 3 ac. Rivers/Streams = 1,615 ft.	San Elijo Lagoon[3]	160	M
Stations					
Solana Beach	0	None	None	15	No impacts - not located within CCBA
Del Mar (Solana Beach Station to I-5/805 Split)					
Alignments					
COVERED TRENCH on bluffs; crosses San Dieguito and Los Penasquitos Lagoons	75	Lakes/Lagoons = 2 ac. Rivers/Streams = 3,025 ft.	San Dieguito Lagoon[4] Los Penasquitos Lagoon (Soledad Lagoon)[3]	125	M
TUNNEL under Camino Del Mar; crosses San Dieguito and Los Penasquitos Lagoons	75	Lakes/Lagoons = 2 ac. Rivers/Streams = 1,310 ft.	San Dieguito Lagoon[4] Los Penasquitos Lagoon (Soledad Lagoon)[3]	140	M - CCBA in the trenching areas and not the tunnel portion
TUNNEL along I-5; crosses San Dieguito and Los Penasquitos Lagoons	35	Lakes/Lagoons = 0.5 ac. Rivers/Streams = 1,520 ft.	San Dieguito Lagoon[4] Los Penasquitos Lagoon (Soledad Lagoon)[3]	145	L – not located in the CCBA
I-5/805 Split To Hwy 52					
Alignments					
Miramar Hill Tunnel	15	Lakes/Lagoons = 0 ac. Rivers/Streams = 455 ft.	None	35	L - not located in the CCBA
I-5 Tunnel	35	Lakes/Lagoons = 0 ac. Rivers/Streams = 320 ft.	None	30	L - not located in the CCBA

TABLE 4-1

Analysis/Comparison Table
Impacts to Hydrology & Water Quality
Los Angeles - Orange County - San Diego (continued)

	Floodplains[1] (acres)	Surface Waters (acres/feet)	303 (d) Impaired Waters[2]	Erosion (acres)	Groundwater (H,M,L)
Stations					
UTC (Only applies to Miramar Hill Tunnel)	0	None	None	25	No impacts - not located within CCBA
Hwy 52 To Santa Fe Depot (Curve realignment; Double Tracking; San Diego River Bridge; Trench between Sassafras St and Cedar St)	15	Lakes/Lagoons = 0 ac. Rivers/Streams = 1,475 ft.	Mission Bay Tecolote Creek San Diego Bay	75	L for bridges and at-grade sections; M for trenching sections
Stations					
Santa Fe Depot	0	Lakes/Lagoons = 2 ac. [5]	San Diego Bay[5]	0	L

[1] Floodplain acreage shown here includes only 100-year floodplains, designated in this report as Special Flood Hazard. Area (SFHA).
[2] 1998 California 303(d) List and TMDL Priority Schedule (Los Angeles, Santa Ana, and San Diego RWQCB)
[3] Listed in [2] as (Water Body Type) Estuary
[4] Listed in [2] as (Water Body Type) Coastal Shoreline
[5] Adjacent to but does not cross surface water.

4.1 NO-PROJECT ALTERNATIVE

The No-Project Alternative in the Los Angeles – Orange County – San Diego region would involve construction of highway and rail improvement projects programmed for completion between now and 2020 (refer to Table 1-1). All potential hydrology and water quality impacts resulting from the No-Project Alternative would be addressed and evaluated in associated environmental documents at a project level. Under the No-Project Alternative, no additional, direct hydrological and water quality impacts would occur beyond those addressed in environmental documents for those projects.

The No-Project Alternative would not provide any opportunity for long-term solutions to the continued erosion problems along the existing rail corridor in the San Clemente and Del Mar areas, caused by wave action, groundwater infiltration, and slope stability. The bluffs would need to be stabilized over the long-term, and drainage facilities maintained or increased, in order to continue reliable rail service in these areas.

4.2 MODAL ALTERNATIVE

The Modal Alternative would require that approximately 1,100 acres of new ROW be acquired between Los Angeles and San Diego, 370 acres of which would be paved, to accommodate the highway and interchange widening proposed under this alternative.[1] Bridges and overpasses would be widened in urban, suburban, coastal, and open-space environments, increasing the footprint of the highway as well as shadow effects beneath the infrastructure.

The primary long-term impact to hydrology and water quality of the Modal Alternative would be the addition of 370 acres of paved surface. This would substantially increase cumulative stormwater runoff and the pollutant load carried by that runoff from the highway into streams, rivers, and lagoons.

Temporary hydrology and water quality impacts during construction of the Modal Alternative would include excavation and soil disturbance activities along the highway alignment, at new or widened interchanges, in water ways and coastal lagoons, and staging areas; generation of spoils; and potential ground surface settlement from trenching and cut and fill operations along hillsides and rock slopes.

The addition of nine gates at the Long Beach Airport is not expected to have any adverse effect on hydrology or water quality.

Floodplains

The I-5 study corridor encompasses approximately 210 acres of Special Flood Hazard Area (100-year floodplain). The majority of these SFHAs occur between Fullerton and Irvine (115 acres), with smaller areas occurring between Irvine and Dana Point, and Oceanside and San Diego.

The widening of I-5 and related improvements, such as bridges, culverts, and drainage ditches, would be an extension of the existing infrastructure. Any potential impacts of the additional infrastructure to the floodplain hydrology are expected to be small and incremental, and likely avoided or mitigated through facility design.

Surface Waters

The Modal Alternative crosses approximately 20 rivers and streams, and five lagoons. Twelve of the rivers and all five lagoons are 303(d) waters. Impacts to surface waters from construction of this alternative would involve alteration of the river/stream channels and tidal lagoons through the placement of new structures and/or modification of existing structures spanning these water bodies. Potential

[1] Acres of right-of-way for the Modal Alternative are estimated based on the need for a minimum of 25 feet of additional pavement width, and 50 feet of unpaved width for drainage, cut and fill, and other unpaved area, for the length of Interstate 5 between Los Angeles and San Diego.

impacts from construction would involve temporary diversion and/or alteration of flows and hydraulics, dredging/excavation and fill, alteration of bed and bank, increased sedimentation from erosion, and discharge of pollutants from dewatering and construction materials. Construction activities would potentially add to the pollutant load and, in particular, sediment loads to the 303(d) impaired water bodies crossed by the Modal Alternative. Impacts to water quality from construction would be temporary for the duration of construction activities. Impacts to water quality during operational activities would result from any discharge of storm water runoff from the facilities to surface waters. Increases in impervious surface and run-off carrying additional pollutant loads from vehicles could result in the further degradation of existing water quality in impaired and non-impaired surface waters.

The I-5 corridor from Union Station to Fullerton is highly urbanized. The Rio Hondo and San Gabriel Rivers are concrete lined and serve as major flood control channels that drain the Los Angeles and San Gabriel basin watershed. Coyote Creek and its main tributaries also provide flood control for primarily urbanized areas. All three rivers receive urban runoff from highly developed areas and are considered impaired. In the Fullerton to Irvine section, the alignment would cross through Orange County where there are thirteen watersheds. Fullerton and Carbon Creeks serve as flood control facilities. The Santa Ana River and Peters Canyon Wash, which is tributary to San Diego Creek, are major watercourses through this area. From Dana Point south to Oceanside, the I-5 approximately parallels the coastline and crosses San Mateo Creek, San Onofre Creek, and the Santa Margarita River. These watercourses are natural, unlined streams and are part of the watershed encompassing the Cleveland National Forest and Camp Pendleton. From the I-5/805 split to Santa Fe Depot, I-5 parallels Mission Bay and San Diego Bay and crosses Tecolote Creek and San Diego River. Both streams are channelized west of I-5 and drain primarily urban areas.

South of Oceanside, the I-5 crosses five lagoons on concrete bridges that extend from earth-filled embankments. Water passes under the bridges through openings between concrete columns/bents. The bridges are relatively short and were originally built on earth-filled embankments that reduced the degree of water circulation in the lagoons. The original natural openings to the ocean are now fixed and narrowed at the bridge locations. In Buena Vista Lagoon, residential development confines the channel mouth to the south end of the lagoon.

If the design of the bridge improvements over the lagoons extend the existing pilings out to the sides and do not affect the opening, then tidal flushing for the lagoons would remain the same. If the design includes reduction and replacement of the earth-fill embankments with bridges or causeways, water circulation in the lagoons could be improved and lead to a higher rate of flushing exchange between the lagoons and the ocean. This type of modification in the lagoons would potentially improve the water circulation and possibly water quality of the lagoons.

The widening of the I-5 bridges over the lagoons would increase the shadow impacts on the lagoons and other surface waters crossed. The additional footprint of the shadow area is not expected to have any substantial impact on the existing hydrologic conditions.

Storm water/Run-off

Storm water run-off from the proposed improvements would be generated from construction and operational activities. Common sources of storm water pollution during construction would include equipment and vehicle leaks of oil, grease, fuel, etc., construction materials, and waste material.

Operational impacts would include substantially increased run-off and pollutant load from an increase of approximately 370 acres of impervious surface. The increased run-off would carry the pollutant load from the increased traffic accommodated by the widening of the interstate highway, and would decrease the water quality in surface waters in the area. This would be of particular concern for the 303(d) impaired waters, including the five lagoons crossed by I-5.

Erosion

Soils located along the entire alignment, within the 100-foot buffer, are shown to be susceptible to erosion (Table 4-1). Impacts related to erosion are primarily based upon soil-specific conditions as well as wind and water erosion. Erosion associated with site preparation and construction would be temporary, until construction was completed and revegetation or other slope stability measures were in place.

Most erosion potential can be controlled and contained through proper design, pollutant prevention plans, and mitigation. Available data does not indicate any areas along the Modal Alternative where erosion problems could seriously impede implementation of the alternative; however, detailed geotechnical analyses would be needed as part of a Tier 2 level analysis.

Groundwater

As described previously, the Modal Alternative would increase the impervious surface and vehicular miles traveled along the length of the corridor, thus increasing run-off and pollutant load. This could potentially affect water quality, as more heavily polluted runoff infiltrates to the groundwater basin.

Sea Level Rise

The character of the coastline is the result of various natural processes, one of which is rising sea levels. This is a growing concern among coastal communities. It is projected that a rise of 19 inches (with a possible range of five to 37 inches) in sea level would occur by the year 2100. A rise in sea level would expose the coastline to increased flooding. Impacts from global warming and rising sea levels are not expected to impact the Modal Alternative due to its inland location. There is some potential for increased tidal action and storm surge to increase erosion around the highway bridge footings in the tidal lagoons.

4.3 HIGH-SPEED TRAIN ALTERNATIVE

Hydrology and water quality impacts related to construction include ground-disturbing activities at shafts, portals, and staging areas; generation of spoils; construction phase vibration and noise; and potential ground surface settlement from trenching/tunneling and excavation. These impacts would be temporary, and would abate as construction is completed and revegetation or surface stabilization measures are put in place.

Overall, it is anticipated that operational activities could have a beneficial effect on hydrology and water quality impacts. Implementation of design options that modify bridge structures across lagoons would allow for improved tidal flushing, improving the quality of the water. Also, the High Speed Train Alternative would likely reduce vehicular miles traveled on the area freeways which would reduce the pollutant load in runoff and reduce potential water quality impacts. Options that would remove the existing rail corridor from coastal bluff areas in San Clemente and Del Mar would reduce long-term bluff erosion and reduce potential impacts from increased storm surge and rising sea levels along the coastal rail route.

A combination of high-speed rail and conventional rail improvements are proposed for the LOSSAN corridor. Construction and operational impacts would be similar for high-speed and conventional rail segments.

There are two proposed pure high-speed rail (i.e., electrified) alignment alternatives in this region. These alignments would involve electrified trains traveling at speeds exceeding 200 miles per hour. One alignment would run between Los Angeles International Airport (LAX) and Union Station, and the other from Union Station to Anaheim via the Union Pacific Railroad (UPRR), with designs for an elevated track, trenching and at-grade. A third high-speed (non-electrified) rail alternative would follow the existing LOSSAN corridor between Union Station and Irvine Station.

Between Irvine Station and San Diego, conventional rail improvements are proposed with several options to increase train speed and efficiency. Options include double-tracking at grade, trenching, and tunneling.

Floodplains

Designated SFHAs were identified for some areas along the high-speed rail routes and potential flood impacts may occur. Most of the SFHAs are between Fullerton and Irvine (LOSSAN Corridor). Floodplain impacts are expected to be low because the additional improvements would be done within established rail corridors designed in the floodplains noted. New underground stations are proposed at LAX and at Edison Field in Anaheim (for the UPRR route option). A new, elevated station is proposed in Norwalk along the UPRR route as well. No designated SFHAs have been identified for the LAX, Anaheim, or Norwalk stations, thus no flood impacts are anticipated at these station sites.

Along the Union Station to Irvine alignment (via LOSSAN), modifications are proposed at the existing stations located in Norwalk, Fullerton, Anaheim, Santa Ana, and Irvine. No designated SFHA has been identified for the improvements at the Norwalk, Fullerton, and Santa Ana Stations. No potential flood impacts are anticipated for these stations. Designated SFHAs were identified for the Anaheim and Irvine Stations, where potential flood impacts could occur. Because the modifications would involve parking expansion and bypass tracks at existing stations, it is expected that any potential flood hazard can be avoided or mitigated through planning and design. Further analysis would be done at the project level for Tier 2.

The City of San Juan Capistrano conventional rail improvement options include double tracking with a covered trench, a tunnel option, and an at-grade and trenched option east of Trabuco Creek. Designated SFHAs were identified for a small portion of the covered trench option, a short length of the Trabuco Creek option, and for the at-grade portions of the tunnel option. Potential flood impacts are anticipated for these segments.

SFHAs have been identified for areas along the Dana Point curve realignment and within the short trench and short tunnel options south of the curve realignment. Potential flood impacts are anticipated for these segments. The long tunnel option (one or two segments) does not encompass any known SFHAs.

Between Oceanside and San Diego, most segments and options would encompass SFHAs, including the trench and at-grade options in Carlsbad and Encinitas, and the trench and tunnel options in Del Mar. Both the covered trench and the tunnel under Camino del Mar would encompass about 75 acres of SFHA, while the I-5 tunnel option crosses about 35 acres in this area. The two tunnel options south of the I-5/805 split both encounter floodplains, but would not be expected to have a substantive impact due to the depth of the tunneling. Small areas of SFHAs are also present along the alignment from Highway 52 to the Santa Fe Depot in San Diego where there is some potential for flooding.

Surface Waters

The high-speed rail alignment option from LAX to Union Station does not cross any rivers, but parallels the Los Angeles River south of Union Station. The high-speed rail alignment via the UPRR (Union Station to Anaheim) crosses 7 rivers and streams, 5 of which are 303(d) waters. The alignment along the LOSSAN corridor (Union Station to Irvine) crosses 11 rivers and streams, 7 of which are 303(d) waters.

Between Irvine and San Diego, the conventional rail options cross approximately 15 streams and rivers, of which 7 are 303(d) waters. In addition, these rail options cross six coastal lagoons in northern San Diego County, all of which are considered to be impaired waters.

Long-term project impacts to surface waters from the High-Speed Train Alternative are expected to be lower than those described under the Modal Alternative, largely because there would be less impervious surface added and substantially less runoff would enter surface waters. Impacts to surface waters from the High-Speed Train options would primarily occur during construction, and could involve temporary diversion and/or alteration of flows, dredging/excavation and fill, alteration of bed and bank, demolition and removal of existing structures, increased sedimentation from erosion, and discharge of pollutants from dewatering and construction materials.

Water quality during operation of the High-Speed Train alternative could improve from the existing condition with the reduction in vehicle miles traveled on area highways. Fewer roadway pollutants would be present in the surface run-off from the roadways. This beneficial effect could be particularly helpful in reducing or slowing the further impairment of 303(d) waters in the project area. Another potential improvement to surface waters could occur in areas where mitigation may include new bridge designs over lagoons and other water bodies that would allow for better water circulation and tidal flushing.

Storm Water/Run-off

Storm water run-off from the proposed improvements would be generated during both construction and operational activities. Common sources of storm water pollution during construction would include equipment and vehicle leaks of oil, grease, fuel, etc., construction materials, and waste material.

Impacts associated with operational storm water run-off are anticipated to be much less than those associated with the Modal Alternative, due to significantly less impervious surface being added (highway pavement versus tracks, trenches or tunnels). Few of the proposed rail improvements would increase existing impervious surfaces by any substantive amount, except the additional parking areas planned for some existing rail stations. Therefore, storm water run-off created by the High-Speed Train Alternative would be minimal. The expected reduction in vehicle miles traveled with the implementation of the High-Speed Train Alternative would also reduce (or, at least, slow the increase of) the pollutant burden in storm water run-off from area highways.

Erosion

Available data indicates that soils susceptible to erosion (i.e., with a factor greater than 3.0) are located in various areas along the full length of the rail corridors, with the exception of the Union Station to Anaheim UPRR route. Most erosion potential can be controlled and contained through proper design, pollutant prevention plans, and mitigation. There are two areas, however, where erosion could be a severe challenge to project construction, from both an engineering and an economic standpoint.

Through the cities of Del Mar and San Clemente, rail corridor improvements are proposed within the area of influence of the present coastal sea bluff. In general, coastal bluff retreat is controlled by a combination of marine erosion and subaerial erosion. Marine erosion results from the effects of the ocean and wave action along the base of the bluffs. Subaerial erosion results from those erosional influences that exist above the high-water line (or wave run-up line) and includes such items as erosion due to surface runoff, ground water seepage, wind, pedestrian traffic, rodent activity, and slope instability. As a result, the bluffs are consistently impacted by marine and subaerial erosional processes.

In Del Mar, the existing rail alignment is constructed across the top of the relatively flat mesa top, generally at or near the elevation of the bluff top, 40 to 65 feet (12 to 20 meters) above mean sea level. In San Clemente, the existing rail alignment is generally on a shallow topographical bench between the base of the coastal bluffs and the beach. The rail alignment and its associated rip-rap protection provide a buffer from wave action, so the cliffs are dominantly subject to subaerial erosional processes. In general, a bluff will lay back and flatten over time until a characteristic slope is achieved.

A number of remedial or stabilization measures exist along the existing railway in the Del Mar and San Clemente areas. These include older improvements along the coastal bluff face through both cities that are in need of ongoing repair and maintenance. For example, in Del Mar, wooden and concrete seawalls along portions of the bluff are currently protecting portions of the base of the bluff against erosion due to typical wave impact. However, these walls are occasionally of insufficient height to block heavy storm surf or at least they require periodic maintenance to remain effective. In San Clemente, the existing rip-rap berms also require maintenance.

The options of double-tracking along the existing rail alignment in Del Mar and in San Clemente would require extensive, long-term stabilization measures to control erosion and slope stability problems. Engineering solutions such as seawalls, additional drainage infrastructure, and tie-back structures could be used, but would add significantly to the impact and expense of these options. For these reasons and others, these two options were eliminated from further consideration during the LOSSAN screening process (refer to Chapter 1).

Erosion potential is not expected to be a substantial construction or operation issue in other areas of the rail alignments.

Groundwater

In the high-speed rail alignments north of Irvine, groundwater impacts are expected to be low in areas proposed for elevated and at-grade construction. Medium impacts to groundwater are anticipated for the trenching sections where they can be located outside the CCBA. New underground stations are proposed at LAX and in Anaheim, where high groundwater impacts could occur. Low impacts to groundwater are anticipated for the elevated station proposed at Norwalk, and at the existing stations along the LOSSAN corridor.

Construction types for the conventional rail corridor between Irvine Station and San Diego include at-grade, trench, and tunnel. Groundwater impacts are anticipated to be low for at-grade construction and medium for trench and tunnel construction throughout the corridor. Station improvements are anticipated to have a low impact on ground water, with the exception of potential new stations at San Juan Capistrano, San Clemente, and University Town Center. These stations are proposed to be depressed below grade and may result in an impact to groundwater, depending upon their location during design stages.

Further study in Tier 2 is needed to determine more specific areas of potential for groundwater impact and to develop site-specific designs to reduce or avoid the impact.

The High-Speed Train Alternative is expected to have a substantially lower impact on groundwater quality due to run-off than the Modal Alternative, due to the much smaller additions of impervious surface that would be constructed. The pollutant load in stormwater run-off, and subsequent infiltration into groundwater, would be lower with the High-Speed Train Alternative due to the reduced vehicle travel on area highways.

Sea Level Rise

No impact from sea-level rise is anticipated on the High Speed Rail alternatives for LAX-Union Station, Union Station-Anahiem, and Union Station-Irvine due to the inland location of the alignments. Impacts from global warming and rising sea levels may impact conventional rail improvements between Irvine Station and San Diego, especially where the improvements are in close proximity to the shoreline.

Rising water levels would have a direct impact on beach erosion, which, in turn, could undermine storm protection structures for the rail. Sea-level rise and associated erosion, storm surge, and flooding could have a direct impact on the rail alignments along the beach and bluffs in Encinitas, San Clemente, and Del Mar. Bridge structures across lagoons in northern San Diego County could also be affected by increased erosion around the footings.

Lagoons

The existing LOSSAN railroad corridor generally parallels the coastline between Capistrano Beach and San Diego. Along this stretch of coast, a number of lagoons have formed where streams flow into the Pacific Ocean (refer to Table 2-1). These lagoons contain a mixture of salt and fresh water, and the water level is often influenced by tidal cycles.

When the rail corridor across the lagoons was originally established, the tracks were typically built on an earth-fill embankment. A relatively short bridge allowed for water to pass under the tracks, but the embankment reduced the degree of water circulation in the lagoon. Where previously the stream channel may have meandered across the lagoon, the opening to the ocean was now fixed at the bridge location. After the railroad was constructed, the old Coast Highway was constructed nearly parallel to the railroad tracks. In most of these lagoons, the highway was also built on an earth-fill embankment, with a bridge opening in line with the railroad bridge opening.

The project design for the High-Speed Train Alternative will be such that, if the proposed improvements are made to the existing rail corridor, there will be no net increase in the existing footprint of the rail infrastructure or fill in the lagoons. This measure will prevent any further reduction in water circulation attributable to the railroad infrastructure.

There is a potential for improving the existing hydrologic conditions in the lagoons, if the existing earth-fill embankments were replaced with new causeway structures and existing bridge spans are widened. The feasibility, costs versus benefits, and effectiveness of improving hydrologic conditions by replacing structures cannot be fully assessed at this program-level evaluation. Those issues would be examined in more detail during Tier 2. The potential effect of structure replacement on lagoon hydrology is described in more detail in Appendix B of this report.

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Appendix A

Appendix A
Conventional Rail Route Combinations for Impact Comparison

As described in Chapter 1 of this Technical Evaluation, there are numerous alignment and construction options in the Conventional Rail portion of the High-Speed Train Alternative for the Los Angeles – Orange County – San Diego Region. To allow a reasonable comparison of impacts among the No-Project, Modal, and High-Speed Train Alternative, the Conventional Rail improvement options are summarized by showing a range of potential impacts (Table 1-4, Chapter 1). This range is represented by two of many possible route combinations between Union Station and San Diego: (1) a Higher Level Infrastructure route, and (2) a Lower Level Infrastructure route. The Higher Level route is based on combining the alignment/construction options (one from each sub-segment) that would involve the most extensive infrastructure investment and/or construction complexity. For example, where a sub-segment has both an at-grade option and a trenching option in the same general alignment, the trenching option was used for the Higher Level route, and the at-grade option was used in the Lower Level route. Where two tunnel options are the only options in one sub-segment, the longer tunnel was included in the Higher Level route. In this way, a range of potential impacts could be bracketed to allow a valid comparison of the High-Speed Train Alternative to the No-Project and the Modal Alternative.

The specific alignment and construction options included in both the Higher and the Lower Level routes are shown in Tables A-1 and A-2. These representative routes do not include any of the options that were eliminated from further consideration during the LOSSAN screening process. It must be emphasized that these routes serve only to provide a reasonable range of impacts for comparative purposes. They do *not* represent any selection of a particular option as preferred. No selection of preferred alignment options will be done until subsequent stages of this project.

Table A-1
LOWER LEVEL INFRASTRUCTURE IMPROVEMENTS

CONVENTIONAL RAIL (LOSSAN) & STATION OPTIONS
Union Station To Fullerton Station (4th main track)
Fullerton Station To Irvine Station
Alignment
AT-GRADE between Walnut Ave (Orange) and E. 17th St. (Santa Ana)
Stations
Fullerton
Anaheim
Santa Ana
Irvine
Irvine Station To San Juan Capistrano City Limits(no improvements)
San Juan Capistrano (City Limits to Avenida Aeropuerto)
Alignment
AT-GRADE and Open TRENCH along east side of Trabuco Creek
Stations
San Juan Capistrano (New, below-grade station)
Dana Point/San Clemente (Avenida Aeropuerto To San Onofre Power Plant)
Alignment
Dana Point Curve Realignment; San Clemente - SHORT TUNNEL; Double Tracking (crossing San Mateo and San Onofre Creeks)
Stations
San Clemente (New Station – location to be determined)
Camp Pendleton (San Onofre Power Plant to Oceanside City Limits - Double tracking; crosses Santa Margarita River)
Oceanside/Carlsbad (Oceanside City Limits to Encinitas City Limits)
Alignments
Carlsbad - AT-GRADE; double tracking; crosses San Luis Rey, Buena Vista , Aqua Hedionda, and Batiquitos Lagoons
Stations
Oceanside
Encinitas/Solana Beach (Encinitas City Limits to Solana Beach Station)
Alignment
Encinitas - AT-GRADE; Double Tracking; crosses San Elijo Lagoon
Stations
Solana Beach
Del Mar(Solana Beach Station to I-5/805 Split)
Alignment
TUNNEL under Camino Del Mar; crosses San Dieguito and Los Penasquitos Lagoons
I-5/805 Split To Hwy 52
Alignment
I-5 Tunnel
Hwy 52 To Santa Fe Depot (Curve realignment; Double Tracking; San Diego River Bridge; Trench between Sassafras St and Cedar St)
Stations
Santa Fe Depot

Table A-2
HIGHER LEVEL INFRASTRUCTURE IMPROVEMENTS

CONVENTIONAL RAIL (LOSSAN) & STATION OPTIONS
Union Station To Fullerton Station (4th main track)
Fullerton Station To Irvine Station
Alignment
TRENCH between Walnut Ave (Orange) and E. 17th St. (Santa Ana)
Stations Fullerton Anaheim Santa Ana Irvine
Irvine Station To San Juan Capistrano City Limits(no improvements)
San Juan Capistrano (City Limits to Avenida Aeropuerto)
Alignment
TUNNEL along I-5 between Hwy 73 and Avenida Aeropuerto (tunnel under Trabuco Creek and San Juan Creek); Double tracking
Dana Point/San Clemente (Avenida Aeropuerto To San Onofre Power Plant)
Alignment
San Clemente - LONG TWO-SEGMENT TUNNEL; Double Tracking (crosses San Mateo and San Onofre Creeks)
Stations
San Clemente (New below-grade station between tunnel segments)
Camp Pendleton (San Onofre Power Plant to Oceanside City Limits - Double tracking; crosses Santa Margarita River)
Oceanside/Carlsbad (Oceanside City Limits to Encinitas City Limits) Alignment
Carlsbad -TRENCH; double-tracking; crosses San Luis Rey, Buena Vista, Aqua Hedionda, and Batiquitos Lagoons
Stations
Oceanside
Encinitas/Solana Beach (Encinitas City Limits to Solana Beach Station)
Alignment
Encinitas - SHORT TRENCH; Double Tracking; crosses San Elijo Lagoon
Stations Solana Beach
Del Mar(Solana Beach Station to I-5/805 Split)
Alignment
TUNNEL along I-5; crosses San Dieguito and Los Penasquitos Lagoons
I-5/805 Split To Hwy 52
Alignment
Miramar Hill Tunnel
Stations UTC
Hwy 52 To Santa Fe Depot (Curve realignment; Double Tracking; San Diego River Bridge; Trench between Sassafras St and Cedar St)
Stations
Santa Fe Depot

Appendix B

Appendix B
Potential Effects of Rail Structure Replacement Across Lagoons in the LOSSAN Corridor

When the LOSSAN rail corridor was originally constructed across a number of lagoons in northern San Diego County, the tracks were typically built on an earth-fill embankment. A relatively short bridge allowed for water to pass under the tracks, but the embankment reduced the degree of water circulation in the lagoon. Where previously the stream channel may have meandered across the lagoon, the opening to the ocean was now fixed at the bridge location. After the railroad was constructed, the old Coast Highway was constructed nearly parallel to the railroad tracks. In most of these lagoons, the highway was also built on an earth-fill embankment, with a bridge opening in line with the railroad bridge opening.

The project design for the High-Speed Train Alternative will be such that, if the proposed improvements are made to the existing rail corridor, there will be no net increase in the existing footprint of the rail infrastructure or fill in the lagoons. This measure will prevent any further reduction in water circulation attributable to the railroad infrastructure.

There is a potential for changing the existing hydrologic conditions in some lagoons, if the existing earth-fill embankments were replaced with new causeway structures. The feasibility, costs versus benefits, and effectiveness of improving hydrologic conditions by replacing structures cannot be fully assessed at this program-level evaluation. Those issues would be examined in more detail during Tier 2. The potential effect of structure replacement on lagoon hydrology is briefly described here.

If causeways were built to carry the new tracks across the lagoon, the causeways would have pile bents or concrete columns that support the tracks, but the obstruction to flow would be much less than the existing embankments. This change would likely increase the water circulation in the lagoons and lead to a higher rate of flushing exchange between the lagoons and the ocean. The one exception to this would be Buena Vista Lagoon. Farther west of the railroad, residential development has encroached on the mouth of Buena Vista Lagoon, forcing the channel opening to the south side of the lagoon. Thus, regardless of project plans and design, the mouth of this lagoon will not be able to meander because of the residential development west of the railroad.

In order to understand the increased water circulation with the design of the proposed project crossing the lagoons, the original construction and design of the railroad through the lagoons needs to be addressed. The tracks were typically built on an earth-fill embankment when the railroad tracks were originally built across these lagoons. A relatively short bridge allowed for water to pass under the tracks, but the embankment reduced the degree of water circulation in the lagoon. Where previously the stream channel may have meandered across the lagoon, the opening to the ocean was now fixed at the bridge location. After the railroad was constructed, the old Coast Highway was constructed nearly parallel to the railroad tracks. In most of these lagoons, the highway was also built on an earth-fill embankment, with a bridge opening in line with the railroad bridge opening.

The replacement of the earth-fill embankments with bridges or causeways would increase the water circulation in the lagoons and lead to a higher rate of flushing exchange between the lagoons and the ocean. This modification in the lagoons could have major impacts on the hydrology of the lagoons. These impacts would be different during different flow conditions as described below.

Low Stream Flow

During much of the year, the flow in the fresh water streams that enter the lagoons is fairly low. The stream meanders through the lagoon and eventually reaches the ocean. In some lagoons the entrance is closed by the beach and is only opened by large stream flows or by mechanical equipment.

Replacing the railroad embankment with a causeway would allow the channel to meander across the width of the lagoon. However, the effect would be limited in those lagoons where the Coast Highway 101 crosses the lagoon next to the railroad. In five of the six major lagoons in the project area, the 101 crosses the lagoons on the west side of the railroad. Therefore, although removing the railroad embankment would increase circulation within the lagoons, the 101 embankment would still constrict the location of the channel mouth. In the sixth lagoon, Buena Vista Lagoon, residential development confines the channel mouth to the south end of the lagoon. In all six of the lagoons, removing the railroad embankment would lead to increased water circulation within the lagoon and possibly better water quality. However, removing the railroad embankments alone would not lead to greater meandering of the channel mouth in any of the lagoons.

High Stream Flow

During winter storms, the fresh water streams entering the lagoons will experience very high flows for short periods of time. The existing railroad embankment has the potential to act as a dam, slowing this flow on its way to the ocean and raising flood water levels in the lagoons. The replacement of the embankment with a series of bridge structures would reduce this backwater effect, potentially lowering the water surface elevation in the lagoons during flood events.

Ocean Surge Storms

The railroad embankment has the potential to shelter the lagoon from strong incoming surges from the ocean. The replacement of the embankment with a series of bridge structures would allow these surges to pass under the tracks, potentially raising the water surface elevation in the lagoons during ocean surge events. However, this effect would be minimal in those lagoons where the 101 embankment lies west of the railroad tracks.

Wave Action in Lagoons

In most lagoons, the existing tracks are on an earth-fill embankment that cuts across the lagoon. If this embankment were replaced with a causeway structure, there would be greater circulation of water around the lagoon. A potential impact could be greater wave action within the lagoon. The existing embankment acts to dampen the energy of waves traveling across the lagoon. If these waves were able to pass under a bridge and continue across the lagoon, there could potentially be greater shoreline erosion.

More detailed analysis of the potential benefits and impacts of structure replacement needs to be conducted in project-specific studies for the High-Speed Train Project.